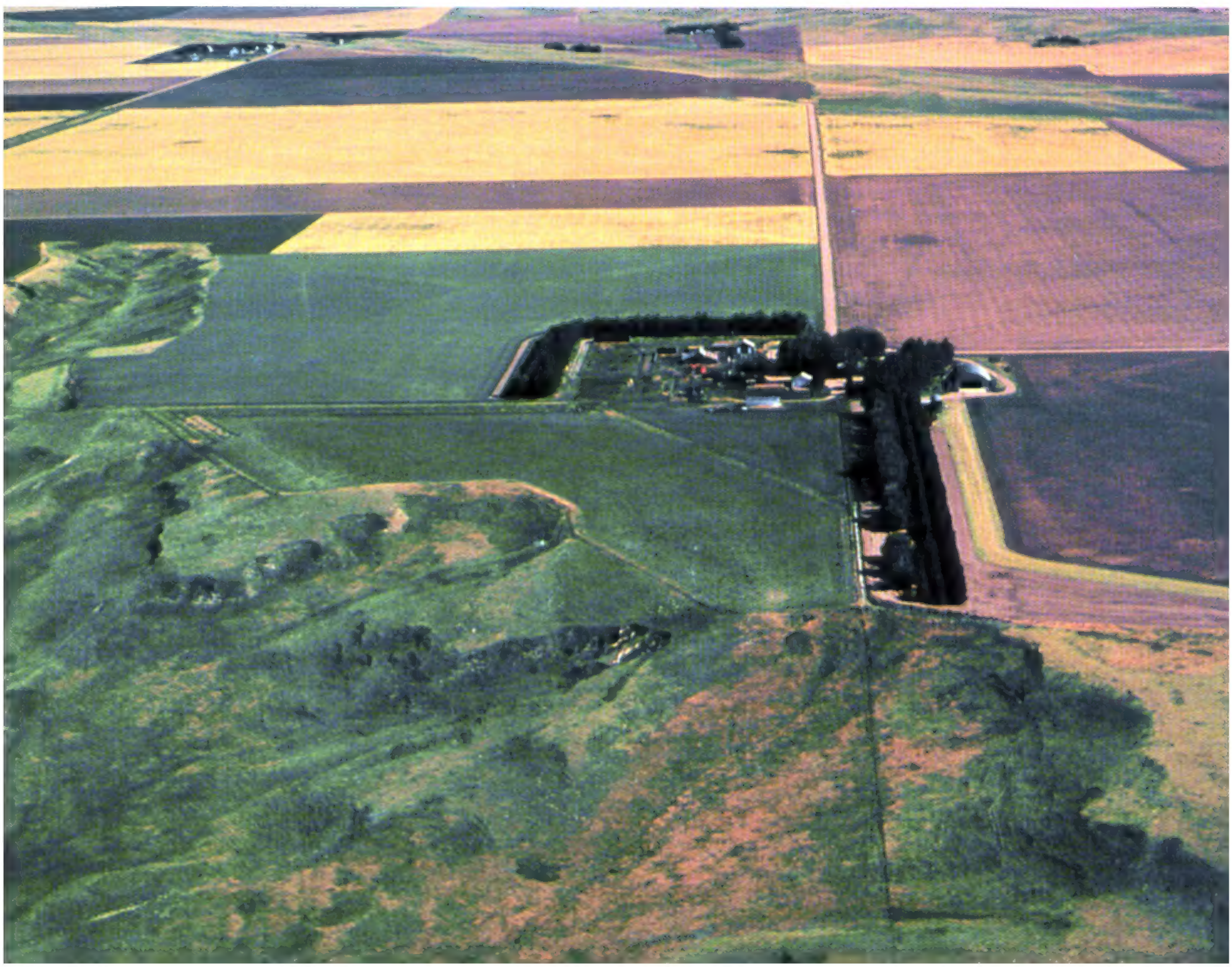
United States
Department of
Agriculture

Natural
Resources
Conservation
Service

In cooperation with
University of Nebraska,
Conservation and Survey
Division

Soil Survey of Keith County, Nebraska



How To Use This Soil Survey

General Soil Map

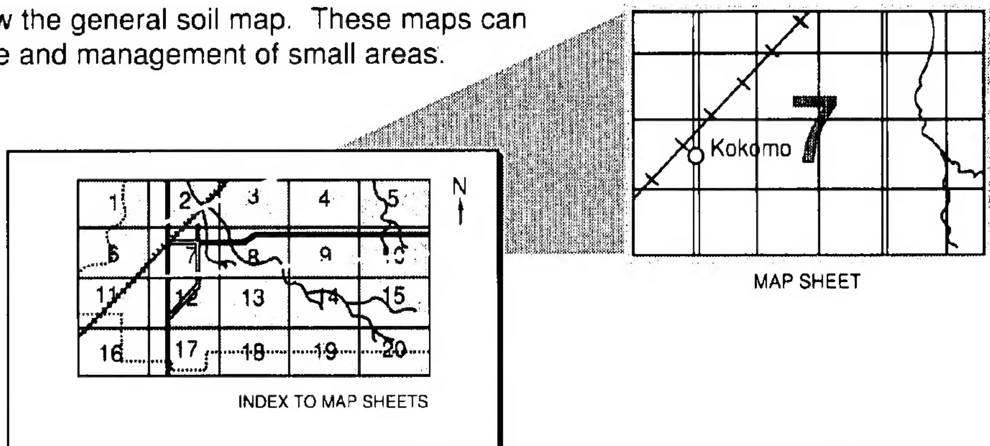
The general soil map, which is the color map preceding the detailed soil maps, shows the survey area divided into groups of associated soils called general soil map units. This map is useful in planning the use and management of large areas.

To find information about your area of interest, locate that area on the map, identify the name of the map unit in the area on the color-coded map legend, then refer to the section **General Soil Map Units** for a general description of the soils in your area.

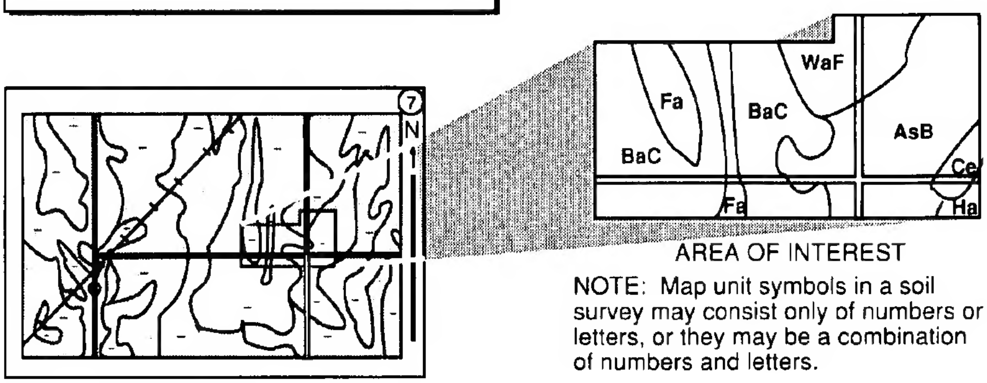
Detailed Soil Maps

The detailed soil maps follow the general soil map. These maps can be useful in planning the use and management of small areas.

To find information about your area of interest, locate that area on the **Index to Map Sheets**, which precedes the soil maps. Note the number of the map sheet, and turn to that sheet.



Locate your area of interest on the map sheet. Note the map unit symbols that are in that area. Turn to the **Index to Map Units** (see Contents), which lists the map units by symbol and name and shows the page where each map unit is described.



MAP SHEET

NOTE: Map unit symbols in a soil survey may consist only of numbers or letters, or they may be a combination of numbers and letters.

The **Summary of Tables** shows which table has data on a specific land use for each detailed soil map unit. See **Contents** for sections of this publication that may address your specific needs.

This soil survey is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (formerly the Soil Conservation Service) has leadership for the Federal part of the National Cooperative Soil Survey.

Major fieldwork for this soil survey was completed in 1988. Soil names and descriptions were approved in 1990. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1989. This survey was made cooperatively by the Natural Resources Conservation Service and the University of Nebraska, Conservation and Survey Division. It is part of the technical assistance furnished to the Twin Platte Natural Resources District. The Twin Platte Natural Resources District provided financial assistance to purchase aerial photographs used in this survey.

Soil maps in this survey may be copied without permission. Enlargement of these maps, however, could cause misunderstanding of the detail of mapping. If enlarged, maps do not show the small areas of contrasting soils that could have been shown at a larger scale.

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Cover: A farmstead and field windbreaks in an area of the Kuma-Duroc-Keith association.

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Issued November 1995

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Foreword

This soil survey contains information that can be used in land-planning programs in Keith County. It contains predictions of soil behavior for selected land uses. The survey also highlights limitations and hazards inherent in the soil, improvements needed to overcome the limitations, and the impact of selected land uses on the environment.

This soil survey is designed for many different users. Farmers, ranchers, and agronomists can use it to evaluate the potential of the soil and the management needed for maximum food and fiber production. Planners, community officials, engineers, developers, builders, and home buyers can use the survey to plan land use, select sites for construction, and identify special practices needed to ensure proper performance. Conservationists, teachers, students, and specialists in recreation, wildlife management, waste disposal, and pollution control can use the survey to help them understand, protect, and enhance the environment.

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are shallow to bedrock. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

These and many other soil properties that affect land use are described in this soil survey. Broad areas of soils are shown on the general soil map. The location of each soil is shown on the detailed soil maps. Each soil in the survey area is described. Information on specific uses is given for each soil. Help in using this publication and additional information are available at the local office of the Natural Resources Conservation Service or the Cooperative Extension Service.

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Soil Survey of Keith County, Nebraska

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United States Department of Agriculture, Natural Resources Conservation Service,
in cooperation with
the University of Nebraska, Conservation and Survey Division

KEITH COUNTY is in southwest Nebraska (fig. 1). The county is rectangular in shape. It is about 41 miles from east to west and about 27 miles from north to south. The total area of the county is 710,284 acres, or about 1,110 square miles. The elevation ranges from about 2,980 feet to 3,800 feet above sea level. Ogallala is at an elevation of 3,216 feet, Brule, 3,287 feet, and Paxton, 3,054 feet. The general slope of the county is eastward.

This soil survey updates the survey of Keith County published in 1926 *(3)*. It gives additional information and has larger maps, which show the soils in greater detail.

Keith County has a diverse economy. The main occupations are farming and ranching and other agriculturally related enterprises. Other occupations are related to retail and wholesale businesses, manufacturing enterprises, medical facilities, tourism, and water sports.

About 57 percent of the county is used as range or pasture, and about 34 percent is used as cropland. About 6 percent of the county is covered by water. These areas of water consist of a lake that covers 35,000 surface acres and the North Platte and South Platte Rivers. The remaining areas in the county are farmsteads or towns. Winter wheat, corn, beans, and alfalfa are grown extensively on the more productive soils. About 43 percent of the cropland is irrigated. Corn, beans, and alfalfa are the main irrigated crops. Crops are used as feed for cattle and hogs or are sold.

Most of the farms located south of the North Platte River include areas of rangeland. The steeper canyons and hills support native grasses. Beef cattle herds are an important part of these farms. The larger ranching enterprises are mainly in the sandhills north of the North Platte River.

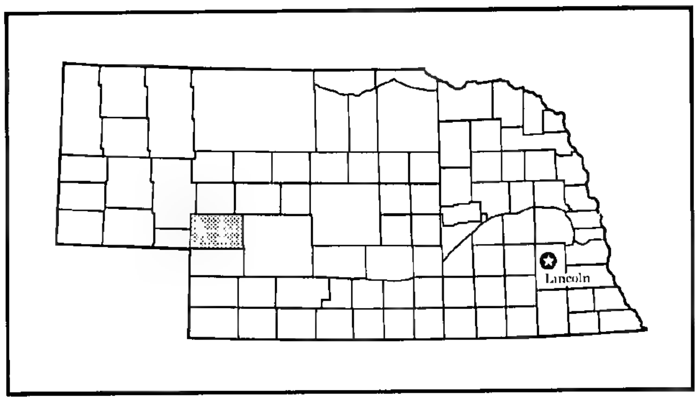

Figure 1.—Location of Keith County in Nebraska.

The major physiographic divisions in Keith County are the silty and loamy soils that formed in loess and loamy material and residuum, the soils of the sandhill region that formed in sandy eolian material, and the soils of bottom land and terraces that formed in the alluvium and colluvium of the North Platte and South Platte Rivers. Water erosion and soil blowing are the main hazards in areas of upland soils. The lack of sufficient rainfall in areas of dryland crops is a management concern during most growing seasons.

Wetness and lowland flooding along the North Platte and South Platte Rivers are hazards during the spring. Proper grazing use is a major management concern in areas of rangeland.

General Nature of the County

This section provides general information about Keith County. It describes history and population; climate; geology; ground water; physiography, relief, and drainage; transportation facilities; and trends in agriculture.

Climate

In Keith County, Nebraska, winters are cold because of incursions of cold, continental air that bring fairly frequent spells of low temperatures. Summers are hot but occasionally are interrupted by cooler air from the north. Snowfall is fairly frequent in winter, but the snow cover is usually not continuous. Rainfall is heaviest in late spring and early summer. The annual precipitation is normally adequate for wheat, sorghum, and range grasses.

Severe duststorms occur occasionally in the spring, when strong, dry winds blow across unprotected soils. Tornadoes and severe thunderstorms, some of which are accompanied by hail, occur occasionally. These storms are local in extent and are of short duration. The damage is variable and spotty.

Table 1 gives data on temperature and precipitation for the survey area as recorded at Ogallala, Nebraska, in the period 1951 to 1981. Table 2 shows probable dates of the first freeze in fall and the last freeze in spring. Table 3 provides data on length of the growing season.

In winter, the average temperature is 27 degrees F and the average daily minimum temperature is 13 degrees. The lowest temperature on record, which occurred at Ogallala on February 1, 1951, is -24 degrees. In summer, the average temperature is 72 degrees and the average daily maximum temperature is 87 degrees. The highest recorded temperature, which occurred on July 11, 1954, is 111 degrees.

Growing degree days are shown in table 3. They are equivalent to "heat units." During the month, growing degree days accumulate by the amount that the average temperature each day exceeds a base temperature (50 degrees F). The normal monthly accumulation is used to schedule single or successive plantings of a crop between the last freeze in spring and the first freeze in fall.

The total annual precipitation is about 18 inches. Of this, more than 14 inches, or about 80 percent, usually falls in April through September. The growing season for most crops falls within this period. In 2 years out of 10, the rainfall in April through September is less than 10 inches. The heaviest 1-day rainfall during the period of record was 3.36 inches at Ogallala on June 5, 1965. Thunderstorms occur on about 47 days each year.

The average seasonal snowfall is about 29 inches. The greatest snow depth at any one time during the period of record was 18 inches. On the average, 1 day of the year has at least 1 inch of snow on the ground. The number of such days varies greatly from year to year.

The average relative humidity in midafternoon is about 50 percent. Humidity is higher at night, and the average at dawn is about 80 percent. The sun shines 70 percent of the time possible in summer and 60 percent in winter. The prevailing wind is from the northwest. Average windspeed is highest, 13 miles per hour, in spring.

History and Population

Keith County had a small but important part in the development of the western United States. The first Europeans came through what is now Keith County in the late 1700's. They were trappers and fur traders from St. Louis that followed the North Platte and South Platte Rivers on their way to the mountains. From the 1840's through the 1860's thousands of pioneers passed through what is now Keith County on the "Great Platte River Road." The Oregon Trail was along the south side of the South Platte River, and the Mormon Trail was along the north side of the North Platte River. The Pony Express Route also passed through the area along the Oregon Trail. Settlements were not made until 1867 when the railroad was completed. In 1873, Keith County was established from part of Lincoln County. The present boundaries of the county were established in 1887. From 1875-85, Ogallala became well known as the end of the Texas Trail cattle drives.

In 1880, the population of Keith County was 194. By 1890, it had increased rapidly to 2,556. The population had decreased slightly by 1900, but since then it has increased steadily. It was about 8,600 in 1990. Ogallala is the largest community and the county seat. It has a population of about 5,100. Other towns are Brule, which is in the southwestern part of the county and Paxton, which is in the southeastern part of the county. Brule has a population of about 410, and Paxton has a population of about 550. Other small towns include Keystone, Lemoyne, Sarben, and Roscoe. The population rate around Lake McConaughy is slowly but steadily increasing as more retired people are settling there.

Geology

Jim Kearney and Mike McCawley, geologists, Natural Resources Conservation Service, helped prepare this section.

The oldest exposed rocks in Keith County are the pinkish to brownish siltstone of the Brule Formation of the Oligocene epoch of the Tertiary period. Near the center of the county, just upstream and downstream of Kingsley Dam and Lake McConaughy, siltstone outcrops in areas along the lower slopes on the south side of the North Platte River valley and in nearby canyons *(4)*. Siltstone is directly beneath the unconsolidated alluvium in the west half of the North Platte River valley and the west fourth of the South Platte River valley. This siltstone has a large percentage of shards and fragments of volcanic glass. It probably originated from wind-deposited silt that was later consolidated.

The Ogallala Group of Miocene age overlies the deeply eroded surface of the Brule Formation in other areas throughout the county. This group originated from ancient flood plain and stream deposits of mostly quartz, feldspar, and rock fragments that were derived from the western mountains. These rocks have lithologies that are silty, carbonate-cemented sandstone; sandy and clayey siltstone; caliche limestone; or sand and gravel. They are grayish, greenish gray, pinkish to reddish, brownish, or white. The Ogallala Group has random lenses of volcanic ash.

The Ogallala Group is exposed over much of the upland areas that are in deeply eroded canyons and breaks along the South Platte River and North Platte River valleys. Scattered areas of unconsolidated Quaternary deposits consisting of windblown loamy and silty material (Bignell Loess and Peorian Loess of the Pleistocene epoch) and sand cover much of the Ogallala Group of the southern upland area. Loess covers much of the Ogallala Group in the western part of the middle upland area, and thin deposits of Pliocene sand and gravel capped with loess cover small areas of the Ogallala Group in the central and eastern parts of this upland area.

Wind-deposited sand of the Nebraska Sandhills are on the uplands north of the North Platte River valley. These extensive sand dunes mantle areas of loess and stream-deposited sand and gravel of Pliocene and Pleistocene age and rocks of the Ogallala Group. The Ogallala Group crops out along canyons and tributary creeks near the North Platte River valley and at isolated small areas throughout the uplands.

Terrace and flood plain deposits of Pleistocene and Recent ages partially fill the North Platte River and South Platte River valleys and their larger tributary valleys. These stream-deposited materials are mostly sand and gravel with interstratified silts and clays. Surficial deposits of silt and sand increase in thickness as the distance from the river increases.

Ground Water

Jim Kearney and Mike McCawley, geologists, Natural Resources Conservation Service, helped prepare this section.

The Brule Formation that underlies all of Keith County forms a relatively impervious zone of bedrock. Wells in areas of joints or fractures yield only small quantities of water.

The Ogallala Group is a principal source of ground water on the uplands south of the North Platte River valley. The basal part of the group consists of unconsolidated sand and gravel that yields water freely to wells. Scattered deposits of sand and gravel at higher elevations in the group may have perched water, but these deposits yield considerably less water. The flow of ground water beneath these uplands is generally east to slightly northeast. The depth to water on the uplands south of the South Platte River valley ranges from 50 to 300 feet. In most of this area water is at a depth of 150 to 250 feet. Water is at a depth of less than 150 feet only along the narrow, steep bluffs that are parallel to the river valley. In recent years the water levels have declined 5 to 30 feet in the western half of the south upland area. The depth to water in most of the middle upland area dividing the North Platte River and South Platte River valleys ranges from 200 to 500 feet. It is shallower in the east and deeper in the west. Water is at a depth of less than 200 feet only beneath the narrow, steep bluffs bordering the valleys. In recent years the water levels have risen some in areas adjacent to Lake McConaughy.

The sandhills north of the North Platte River valley are a large area of ground-water recharge. The fine sands comprising the sandhills do not yield water freely to wells, but the coarse sand and gravel of Pliocene and Pleistocene age that underlie the dunes are a good source of water. The flow of ground water beneath the sandhills is generally south towards the North Platte River valley. Water generally is at a depth of less than 100 feet and often at a depth of less than 50 feet in interdune areas. In a few isolated locations beneath the higher hills it is at a depth of 250 to 300 feet.

The unconsolidated deposits of Quaternary age that consist largely of alluvial sand and gravel are the principal source of ground water within the North Platte River and South Platte River valleys and their major tributaries. Water is at a depth of 0 to less than 50 feet.

The ground-water supply adequately meets the county's need for domestic and livestock water use. Municipal wells derive adequate water supplies from

valley alluvium and occasionally from the Ogallala Group. The greatest concentration of irrigation wells is in the South Platte River valley west of Ogallala and in the North Platte River valley east of Kingsley Dam. As of March 1986, 872 wells were registered in these areas. Some smaller numbers of pivot systems are in the south upland area.

The ground water throughout the county is generally of good quality, although it is hard. It can be contaminated by nitrates and bacteria because of drainage from feedlots and the use of agricultural fertilizers and chemicals. Areas that have sandy soils and shallow water tables are the most likely to have problems with contamination.

Physiography, Relief, and Drainage

Keith County is in two major land resource areas. The Nebraska Sand Hills area is north of the North Platte River and the Central High Tableland area is south of the river.

The three physiographic regions are the sandhills, the tableland, and the bottom land and stream terraces of the North Platte and South Platte Rivers.

The sandhills consist mainly of stabilized rolling hills and dunes. Some landscapes have an irregular appearance. In places without vegetation, blowouts occur because of loose, unstable, blowing sand. Little surface drainage occurs in the sandhills because precipitation is readily absorbed by the sandy soils. A few small lakes and marshes are in the sandhill valleys. A few spring-fed creeks flow out of the sandhills into the North Platte River.

The tableland south of the South Platte River and an area between the two rivers in the western half of the county are characterized by an undulating, nearly level topography. Many shallow depressions are in the tableland. The areas around the tableland that drain into the North Platte and South Platte Rivers range from gently sloping to very steep. Most of the tableland is well drained.

The stream terraces and bottom land consist of colluvial and alluvial material along the North Platte and South Platte Rivers. The stream terraces are nearly level to gently sloping and are well drained. The bottom land is mostly moderately well drained to poorly drained. Some low areas are occasionally flooded.

The general drainage of the county is to the east. The main drainageways are the North Platte and South Platte Rivers and their tributaries. Most of the spring-fed sandhill creeks flow throughout the year. The remaining draws and canyons flow only during storms or in years that have above average rainfall. The flow of water beneath the sandhills is generally south towards the North Platte River valley.

Transportation Facilities

Good transportation facilities are available in Keith County. Interstate 80, U.S. Highway 30, and the main line of a railroad are parallel to the South Platte River in the southern part of the county. U.S. Highway 26 extends from northwest of Ogallala to Scottsbluff. Nebraska Highway 61 provides a north-south route in the center part of the county. Nebraska Highway 92 provides transportation in the northwestern part of the county. A railroad is parallel to the North Platte River.

Rural roads generally follow section lines in the areas of the county that are used as cropland. Some north-south roads are in the sandhills. Most roads are graveled, and a few roads are paved.

Ogallala has a modern airport facility that provides air service for charter, private, and agricultural business use.

Trends in Agriculture

Ranching and farming have been the most important enterprises in Keith County since its settlement. The number of ranches and farms in the last 20 years has slowly declined, but the size has increased. Livestock ranching is the main agricultural enterprise in the sandhills in the northern part of the county. The production of corn and wheat is the most important enterprise on farms. About 34 percent of the county is cropland. About 43 percent of the cropland is irrigated. The amount of irrigated cropland has increased about 3 percent in the last 20 years. The main irrigated crops are corn; dry, edible beans; and alfalfa. Winter wheat is the main dryland crop.

The development of irrigation has been an important part of agriculture in Keith County. As early as the 1890's small irrigation districts diverted water from the North Platte and South Platte Rivers to irrigate land along those rivers. In the 1950's and 1960's, the number of irrigation wells rapidly increased along the river valleys and on the tableland south of the South Platte River. Other irrigation wells are scattered throughout the county in areas where water can be located. In recent years the trend has been to convert cropland in the sandhills back to range, irrigated grasses, or pasture. Approximately 105,000 acres of irrigated cropland is in the county. The water for irrigation is transferred to the fields by irrigation wells and canals from water impoundment reservoirs.

Kingsley Dam and Lake McConaughy, with a surface area of 35,000 acres, have had a major effect on Keith County (fig. 2). The lake provides irrigation water for

Figure 2.—Lake McConaughy and Kingsley Dam provide hydroelectric power and opportunities for recreational activities and enterprises related to tourism to Keith County and surrounding areas.

many counties downstream and supplies water for several power plants. Water sports and tourism are an important part of the economy in the county. A few areas around Lake McConaughy are being developed into building sites and campgrounds.

How This Survey Was Made

This survey was made to provide information about the soils in the survey area. The information includes a description of the soils and their location and a discussion of the suitability, limitations, and management of the soils for specified uses. Soil scientists observed the steepness, length, and shape of slopes; the general pattern of drainage; the kinds of crops and native plants growing on the soils; and the kinds of bedrock. They dug many holes to study the soil profile, which is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

The soils in the survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil is associated with a particular kind of landscape or with a segment of the landscape. By observing the soils in the survey area and relating their position to specific segments of the landscape, a soil scientist develops a concept, or model, of how the soils were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually

change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. The system of taxonomic classification used in the United States is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot assure that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Some soil boundaries and soil names in this survey do not fully match those in the surveys of adjoining counties that were published at an earlier date. Differences are the result of changes and refinements in series concepts, variations in slope groupings, and application of the latest soil classification system.

Map Unit Composition

A map unit delineation on a soil map represents an area dominated by one major kind of soil or an area dominated by two or three kinds of soil. A map unit is identified and named according to the taxonomic classification of the dominant soil or soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural objects. In common with other natural objects, they have a characteristic variability in their properties. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of soils of other taxonomic classes. Consequently, every map unit is made up of the soil or soils for which it is named and some soils that belong to other taxonomic classes. These latter soils are called inclusions or included soils.

Most inclusions have properties and behavioral patterns similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting (similar) inclusions. They may or may not be mentioned in the map unit descriptions. Other inclusions, however, have properties and behavior divergent enough to affect use or require different management. These are contrasting (dissimilar) inclusions. They generally occupy small areas and cannot be shown separately on the soil maps because of the scale used in mapping. The inclusions of contrasting soils are mentioned in the map unit descriptions. A few inclusions may not have been observed and consequently are not mentioned in the descriptions, especially where the soil pattern was so complex that it was impractical to make enough observations to identify all of the kinds of soil on the landscape.

The presence of inclusions in a map unit in no way diminishes the usefulness or accuracy of the soil data. The objective of soil mapping is not to delineate pure taxonomic classes of soils but rather to separate the landscape into segments that have similar use and management requirements. The delineation of such landscape segments on the map provides sufficient information for the development of resource plans, but onsite investigation is needed to plan for intensive uses in small areas.

General Soil Map Units

The general soil map at the back of this publication shows the soil associations in this survey area. Each association has a distinctive pattern of soils, relief, and drainage. Each is a unique natural landscape. Typically, an association consists of one or more major soils and some minor soils. It is named for the major soils. The soils making up one association can occur in another but in a different pattern.

The general soil map can be used to compare the suitability of large areas for general land uses. Areas of suitable soils can be identified on the map. Likewise, areas where the soils are not suitable can be identified.

Because of its small scale, the map is not suitable for planning the management of a farm or field or for selecting a site for a road or building or other structure. The soils in any one association differ from place to place in slope, depth, drainage, and other characteristics that affect management.

In addition to the acreage listed in the association descriptions, about 6 percent of the total acres in the county is water, which consists mostly of Lake McConaughy and the North Platte and South Platte Rivers.

Soil Descriptions

1. Valent Association

Very deep, nearly level to very steep, excessively drained, sandy soils that formed in sandy eolian material; on uplands

This association consists mainly of soils on hummocks and dunes and in choppy areas on sandhills. Slopes range from 0 to 60 percent.

This association has a total area of about 276,470 acres, or about 39 percent of the county. It is about 95 percent Valent soils and 5 percent minor soils (fig. 3).

Typically, the surface layer is grayish brown, loose fine sand about 6 inches thick. Next is a transitional layer of pale brown, loose fine sand about 5 inches thick. The underlying material to a depth of more than 60 inches is very pale brown, loose fine sand.

Of minor extent in this association are Ipage and Cullison soils. Ipage soils are moderately well drained. They are in landscape positions lower than those of the Valent soils. Cullison soils are poorly drained and very poorly drained. They have dark colors below a depth of 10 inches. They are in depressions.

Ranches in this association are mainly cow-calf livestock enterprises. Some small areas are cultivated. Irrigation is provided by center-pivot systems.

Soil blowing and drought are the main hazards. Proper grazing use, a grazing system in which two or more pastures are alternately grazed and rested and the order of the grazing and rest periods is changed each year, properly located livestock watering and salting facilities, and reseeding of areas that were previously cultivated help to maintain or improve the range condition.

2. Sarben-Vetal Association

Very deep, nearly level to moderately steep, well drained, sandy soils that formed in sandy and loamy eolian material; on uplands

This association consists mainly of soils on narrow ridges and side slopes and in swales. Slopes range from 0 to 20 percent.

This association has a total area of about 43,630 acres, or about 6 percent of the county. It is about 68 percent Sarben soils, 26 percent Vetal soils, and 6 percent minor soils (fig. 4).

Sarben soils are on nearly level to moderately steep narrow ridges and side slopes. Typically, the surface layer is grayish brown, friable loamy fine sand about 5 inches thick. Next is a transitional layer of brown very fine sandy loam about 6 inches thick. The underlying material extends to a depth of 60 inches or more. It is pale brown very fine sandy loam in the upper part and calcareous loamy very fine sand in the lower part.

Vetal soils are in nearly level to very gently sloping upland swales. Typically, the surface layer is grayish brown, very friable loamy fine sand about 8 inches thick. The subsurface layer is dark grayish brown and dark gray, friable very fine sandy loam about 24 inches thick. Next is a transitional layer of brown, very friable very fine sandy loam about 6 inches thick. The

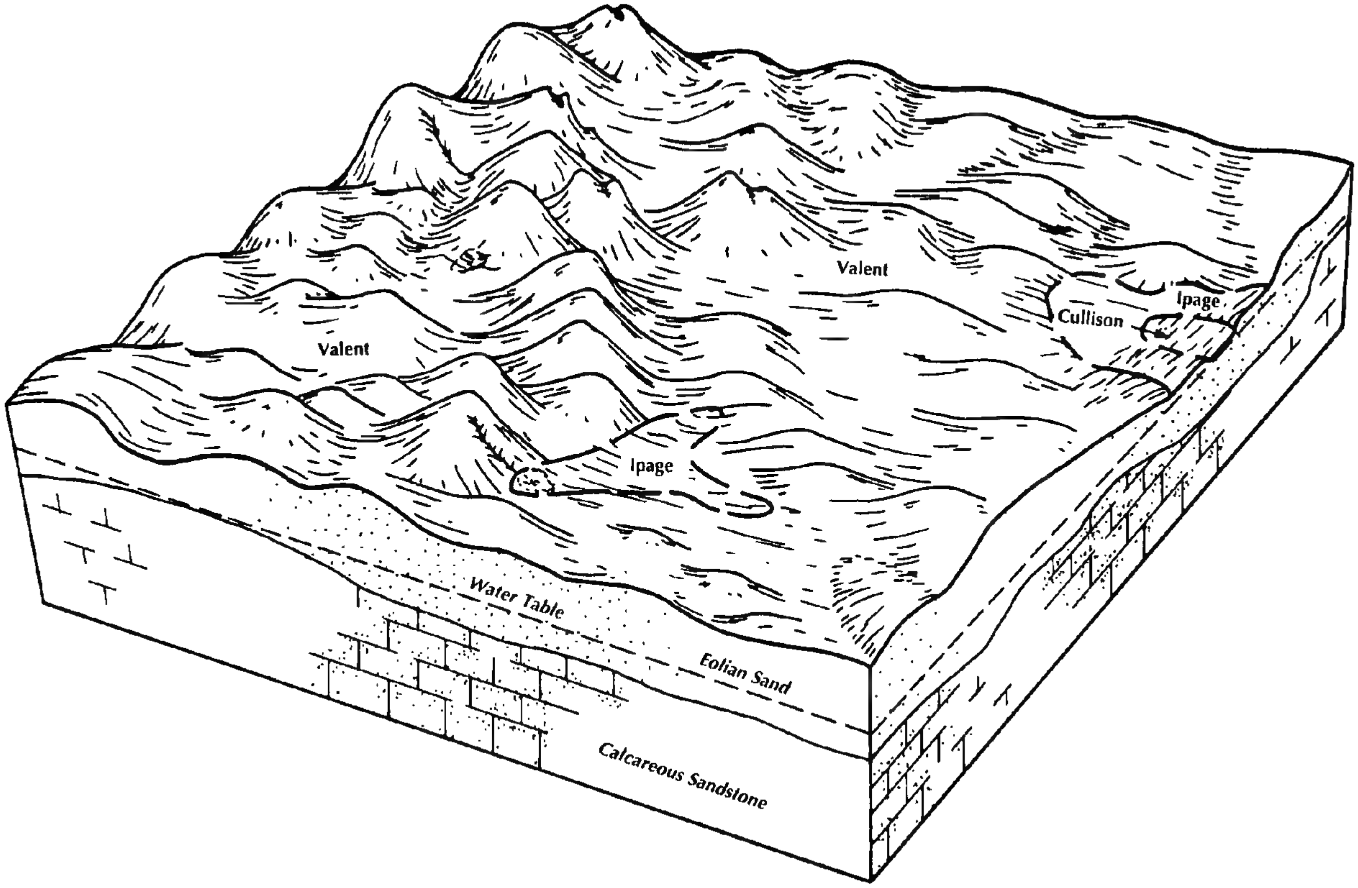

Figure 3.—Typical pattern of soils and parent material in the Valent association.

underlying material to a depth of 60 inches or more is pale brown loamy fine sand.

Of minor extent in this association are Valent soils. Valent soils are sandy. They are on hummocks and dunes.

The major soils in this association are used for diversified farming. Most farms combine grain and livestock enterprises. Most areas are dry-farmed. Winter wheat is the principal dryland crop. A few small areas are irrigated. Beans, alfalfa, and corn are crops grown in these areas.

Water erosion, soil blowing, and drought are hazards. A system of conservation tillage that leaves crop residue on the surface helps to control soil blowing and water erosion and conserve moisture. Summer fallowing can help to increase the moisture supply needed for winter wheat.

3. Satanta-Dix-Altvan Association

Very deep, nearly level to steep, well drained and excessively drained, loamy soils that formed in loamy and gravelly material; on uplands

This association consists of soils on ridges and side slopes. Slopes range from 0 to 30 percent.

This association has a total area of about 33,280 acres, or about 5 percent of the county. It is about 56 percent Satanta soils, 16 percent Dix soils, 15 percent Altvan soils, and 13 percent minor soils.

Satanta soils are on nearly level to strongly sloping broad ridges and the upper side slopes. They are well drained. Typically, the surface layer is grayish brown, friable loam about 6 inches thick. The subsoil is about 28 inches thick. It is dark grayish brown, friable loam in the upper part, brown, friable loam in the next part, and light gray, calcareous, friable loam in the lower part.

The underlying material to a depth of more than 60 inches is pale brown and very pale brown loam.

Dix soils are on gently sloping to steep narrow ridges and gullied side slopes. They are excessively drained. Typically, the surface layer is grayish brown, very friable gravelly loam about 4 inches thick. Next is a transitional layer of yellowish brown, loose gravelly loamy coarse sand about 6 inches thick. The underlying material to a depth of more than 60 inches is yellowish brown, loose very gravelly coarse sand.

Altvan soils are on strongly sloping to moderately steep broad convex or plane side slopes. They are well drained. Typically, the surface layer is brown, friable loam about 5 inches thick. The subsoil is about 29 inches thick. It is brown, firm loam in the upper part, pale brown, friable loam in the next part, and light brownish gray, calcareous, friable loam in the lower part. The underlying material to a depth of more than 60 inches is very pale brown, loose, gravelly coarse sand.

Of minor extent in this association are Bankard and Sarben soils. Bankard soils are sandy. They are in drains that formed in alluvial material. They are in landscape positions lower than those of the Altvan and Dix soils. Sarben soils are loamy. They are on the upper side slopes.

The major soils in this association are used for diversified farming. Most farms combine grain and livestock enterprises. About half of the area is dry-farmed. Winter wheat is the principal dryland crop. The rest of the area is used as range or pasture.

Water erosion, soil blowing, and drought are hazards. A system of conservation tillage and terracing help to control water erosion. Leaving crop residue on the surface helps to control soil blowing. Summer fallowing can help to increase the moisture supply in the subsoil. Proper grazing use, timely deferment of grazing, and a grazing system in which two or more pastures are alternately grazed and rested and the order of the grazing and rest periods is changed each year help to maintain or improve the range condition.

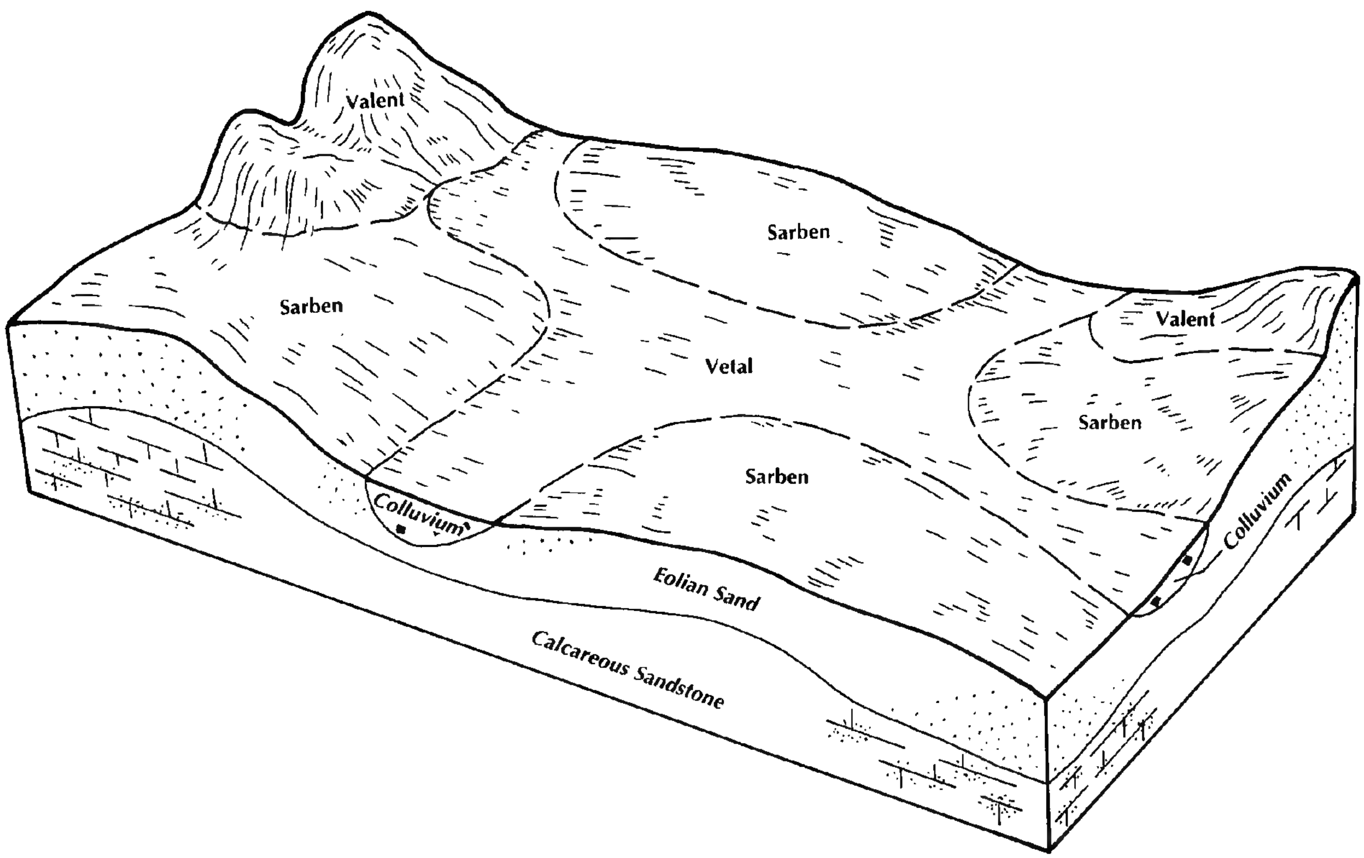

Figure 4.—Typical pattern of soils and parent material in the Sarben-Vetal association.

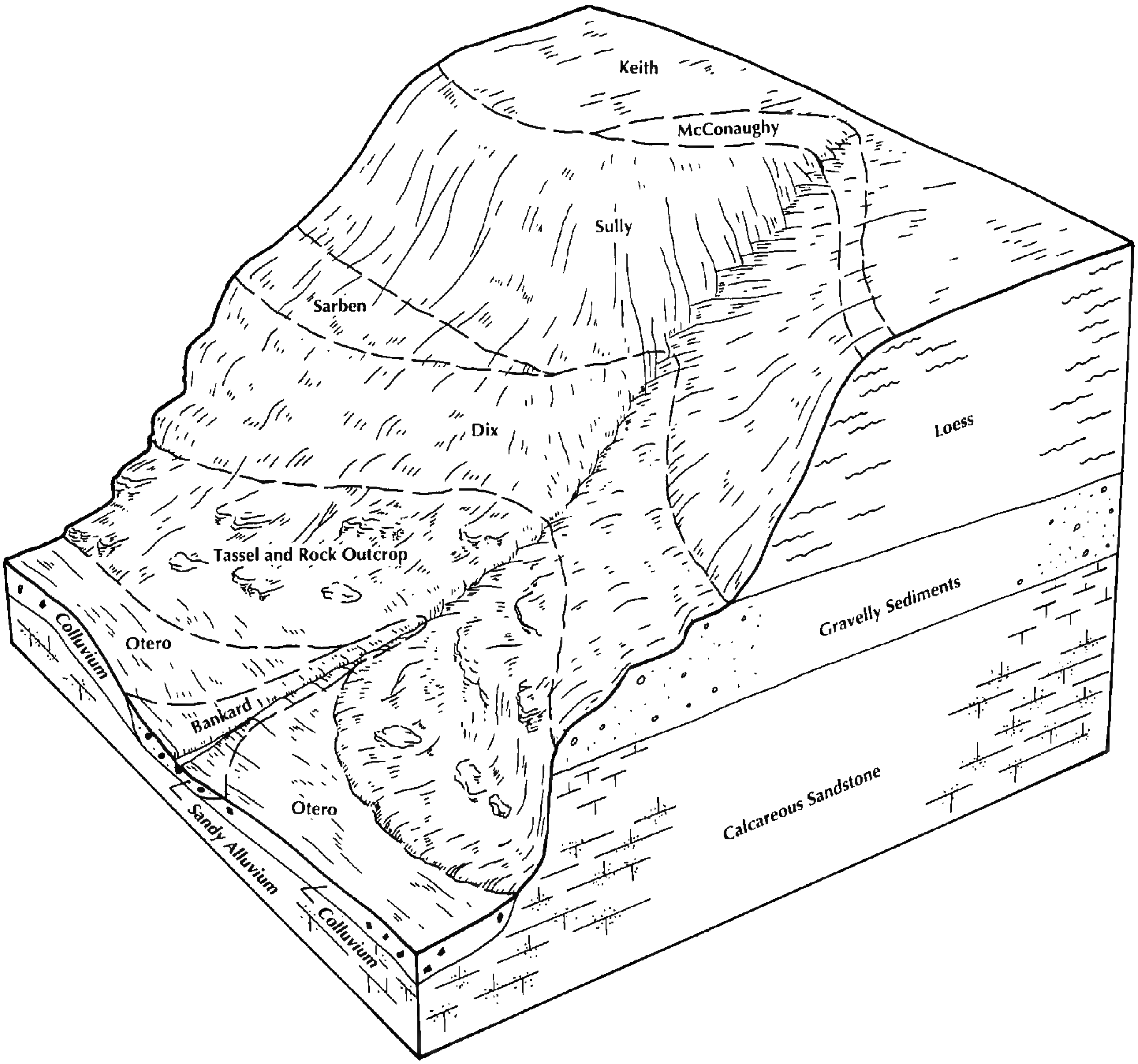

Figure 5.—Typical pattern of soils and parent material in the Sully-Dix-Tassel association.

4. Sully-Dix-Tassel Association

Very shallow, shallow, and very deep, gently sloping to very steep, well drained to excessively drained, loamy soils that formed in loess, gravelly material, and calcareous sandstone bedrock; on uplands

This association consists of soils on side slopes and breaks and in canyons. Slopes range from 3 to 60 percent.

This association has a total area of about 48,460 acres, or about 7 percent of the county. It is about 51 percent Sully soils, 16 percent Dix soils, 9 percent Tassel soils, and 23 percent minor soils (fig. 5).

Sully soils are on strongly sloping to very steep upper side slopes and in canyons. They are well drained. Typically, the surface soil is brown, friable loam about 3 inches thick. Next is a transitional layer of pale brown, friable, calcareous silt loam about 15 inches

thick. The underlying material to a depth of more than 60 inches is pale brown and very pale brown, calcareous silt loam.

Dix soils are on gently sloping to very steep side slopes and breaks and in canyons. They are excessively drained. Typically, the surface layer is grayish brown, very friable gravelly loam about 4 inches thick. Next is a transitional layer of yellowish brown, very friable gravelly loamy coarse sand about 6 inches thick. The underlying material to a depth of more than 60 inches is loose, very gravelly coarse sand.

Tassel soils are on moderately steep to very steep breaks and in canyons. They are somewhat excessively drained. Typically, the surface layer is grayish brown, very friable very fine sandy loam about 4 inches thick. Next is a transitional layer of grayish brown, friable very fine sandy loam about 3 inches thick. The underlying material extends to a depth of more than 60 inches. It is light brownish gray, friable loamy very fine sand in the upper part and very pale brown and white, calcareous sandstone bedrock in the lower part.

Of minor extent in this association are Bankard, Keith, McConaughy, Otero, and Sarben soils and areas of rock outcrop. Bankard soils are sandy. They are in drainageways that are subject to frequent flooding. Keith soils formed in loess. They are on nearly level to gently sloping ridges. McConaughy soils are very deep, silty soils that formed in loess. They have dark colors below a depth of 10 inches. Otero soils are very deep, loamy soils that formed in colluvium. They are in landscape positions lower than those of the Tassel soils. Sarben soils are very deep, loamy soils. They are on shoulders and backslopes. The areas of rock outcrop are on ledges on the lower part of the side slopes and in canyons.

Farms and ranches in this association are diversified. The portion of the farms or ranches that is in this association is in range and is used for livestock grazing. Livestock wells generally can be established in areas of this association. Water erosion and drought are hazards. Overgrazing can reduce the quantity of plants and result in a severe hazard of water erosion. The

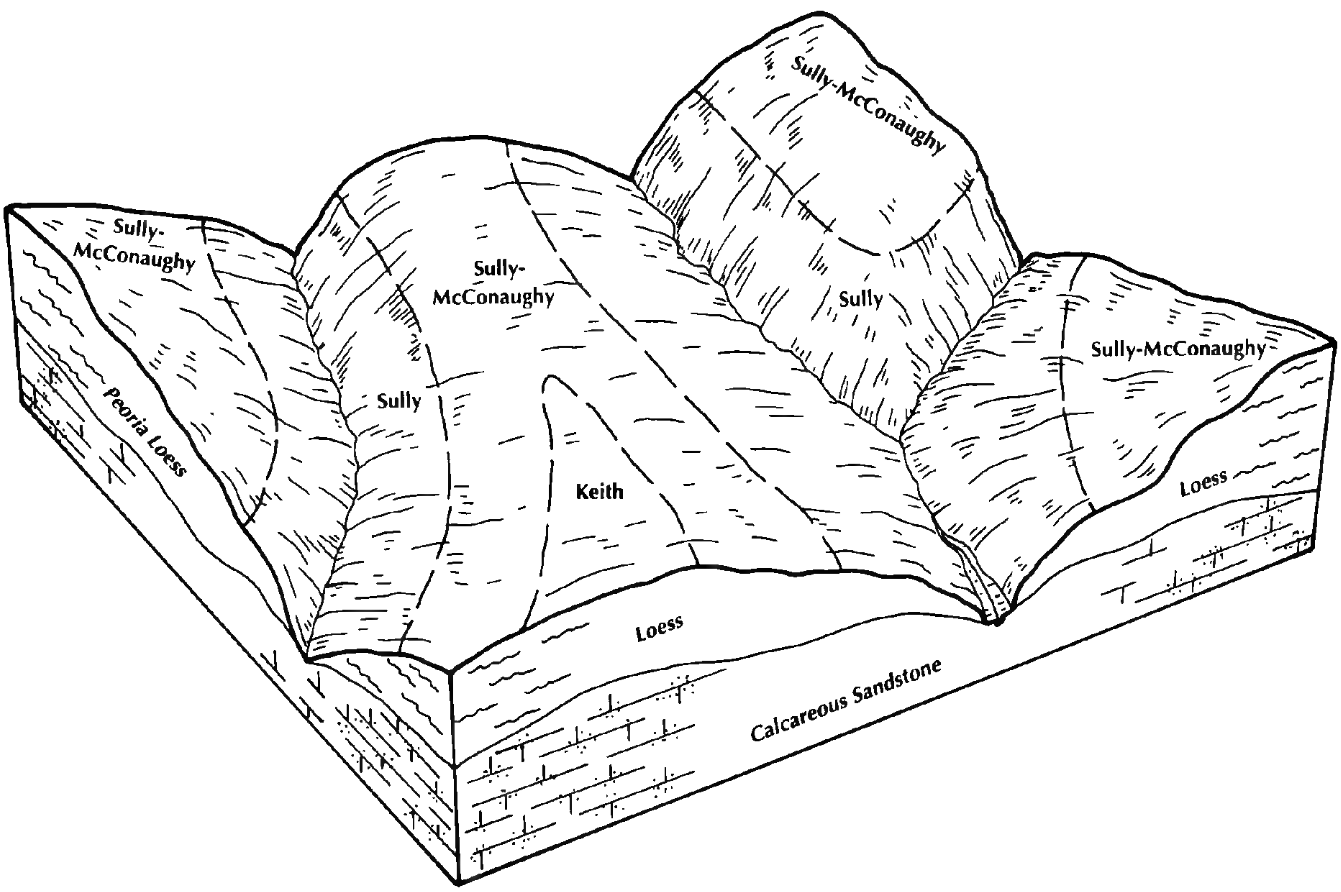

Figure 6.—Typical pattern of soils and parent material in the Sully-McConaughy association.

invasion of shrubs, herbs, and woody plants can be a problem.

Proper grazing use, timely deferment of grazing, and a grazing system in which two or more pastures are alternately grazed and rested and the order of grazing and rest periods is changed each year help to maintain or improve the range condition.

5. Sully-McConaughy Association

Very deep, strongly sloping to very steep, well drained, loamy soils that formed in loess; on uplands

This association consists mainly of soils on rolling hills and side slopes. Slopes range from 6 to 60 percent.

This association has a total area of about 36,040 acres, or about 5 percent of the county. It is about 66 percent Sully soils, 27 percent McConaughy soils, and 7 percent minor soils (fig. 6).

Sully soils are on strongly sloping to very steep rolling hills and side slopes. Typically, the surface soil is brown, friable loam about 3 inches thick. Next is a transitional layer of pale brown, friable, calcareous silt loam about 15 inches thick. The underlying material to a depth of more than 60 inches is pale brown and very pale brown, calcareous silt loam.

McConaughy soils are on strongly sloping to moderately steep slopes that are less than 15 percent and in linear or concave positions on the landscape. Typically, the surface soil is grayish brown, friable loam about 13 inches thick. The subsoil is about 21 inches thick. It is brown, friable loam in the upper part, pale brown, calcareous very fine sandy loam in the next part, and very pale brown, calcareous loam in the lower part. The underlying material to a depth of more than 60 inches is very pale brown, calcareous very fine sandy loam.

Of minor extent in this association are Dix, Duroc, and Keith soils. Dix soils have very gravelly coarse sand above a depth of 10 inches. They are on narrow ridges. Duroc soils have dark colors below a depth of 20 inches. They are in swales. Keith soils have more clay in the subsoil than the Sully and McConaughy soils. They are on summits that are higher on the landscape than the Sully and McConaughy soils.

Farms and ranches in this association are diversified. The portion of the farms or ranches that is in this association is in range and is used for livestock grazing. Some small areas are used for cropland. Livestock wells generally can be established in areas of this association. Water erosion and drought are hazards. Overgrazing can reduce the quantity of plants and result in a severe hazard of water erosion. The invasion of shrubs, herbs, and woody plants can be a problem.

Proper grazing use, timely deferment of grazing, and a grazing system in which two or more pastures are alternately grazed and rested and the order of the grazing and rest periods is changed each year help to maintain or improve the range condition.

6. Kuma-Duroc-Keith Association

Very deep, nearly level to gently sloping, well drained, loamy and silty soils that formed in loess; on uplands

This association consists mainly of soils in long, smooth areas on upland divides. Slopes range from 0 to 6 percent.

This association has a total area of about 62,890 acres, or about 9 percent of the county. It is about 38 percent Kuma soils, 29 percent Duroc soils, 29 percent Keith soils, and 4 percent minor soils.

Kuma soils are on nearly level to very gently sloping upland divides. Typically, the surface layer is dark grayish brown, friable loam about 5 inches thick. The subsoil is about 31 inches thick. It is dark grayish brown, firm silty clay loam in the upper part. A buried surface soil is at a depth of about 12 inches. It is dark grayish brown, friable silty clay loam in the upper part, dark grayish brown silty clay loam in the next part, and grayish brown silt loam in the lower part. The layer of accumulated lime is pale brown, calcareous loam. The underlying material to a depth of more than 60 inches is very pale brown and light gray loam.

Duroc soils are in nearly level to very gently sloping upland swales. Typically, the surface layer is grayish brown, friable silt loam about 6 inches thick. The subsurface layer is grayish brown, friable silt loam about 19 inches thick. The subsoil is brown, calcareous silt loam about 25 inches thick. The underlying material to a depth of more than 60 inches is pale brown, calcareous silt loam.

Keith soils are on nearly level to gently sloping ridges. Typically, the surface layer is dark grayish brown, very friable loam about 6 inches thick. The subsurface layer also is dark grayish brown, very friable loam. It is about 5 inches thick. The subsoil is about 21 inches thick. It is brown and grayish brown, friable silt loam in the upper part and very pale brown, very friable silt loam in the lower part. The underlying material to a depth of more than 60 inches is very pale brown silt loam.

Of minor extent in this association are Lodgepole and Sully soils. Lodgepole soils are somewhat poorly drained. They are in potholes. Sully soils do not have a dark surface layer. They are in the strongly sloping or steeper areas.

The major soils in this association are used for diversified farming. Most farms combine grain and

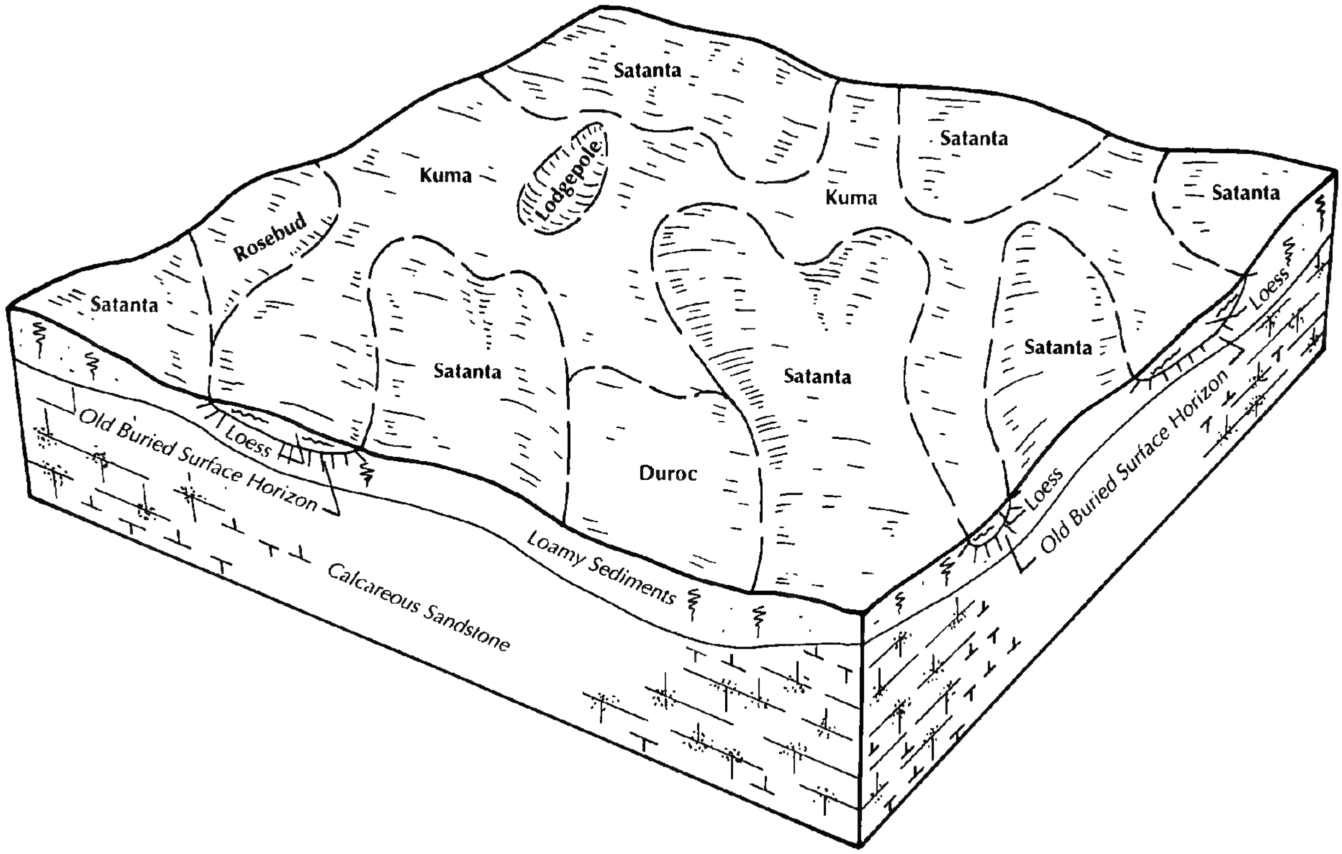

Figure 7.—Typical pattern of soils and parent material in the Satanta-Kuma association.

livestock enterprises. Most areas are dry-farmed. Winter wheat is the principal dryland crop. A few small areas are irrigated. Irrigation is mainly provided by sprinkler systems. Livestock wells generally cannot be easily established in areas of this association.

Water erosion, soil blowing, and drought are hazards. A system of conservation tillage and terracing help to control water erosion. Leaving crop residue on the surface helps to control soil blowing. Summer fallowing can help to increase the moisture supply.

7. Satanta-Kuma Association

Very deep, nearly level to gently sloping, well drained, loamy soils that formed in loamy material and loess; on uplands

This association consists mainly of soils on tableland and in swales that have some small depressions. Typically, slopes range from 0 to 6 percent, but in some small areas the range is 0 to 9 percent.

This association has a total area of about 72,490 acres, or about 10 percent of the county. It is about 51 percent Satanta soils, 39 percent Kuma soils, and 10 percent minor soils (fig. 7).

Satanta soils are on nearly level to gently sloping ridges and the upper side slopes. Typically, the surface layer is grayish brown, friable loam about 6 inches thick. The subsoil is about 28 inches thick. It is dark grayish brown, friable loam in the upper part, brown, friable loam in the next part, and light gray, friable, calcareous loam in the lower part. The underlying material to a depth of more than 60 inches is pale brown and very pale brown loam.

Kuma soils are on nearly level to very gently sloping upland divides. Typically, the surface layer is dark grayish brown, friable loam about 5 inches thick. The subsoil is dark grayish brown, firm silty clay loam about 31 inches thick. A buried surface soil is at a depth of about 12 inches. It is dark grayish brown, friable silty clay loam in the upper part, dark grayish brown silty clay loam in the next part, and grayish brown silt loam in the lower part. The layer of accumulated lime is pale

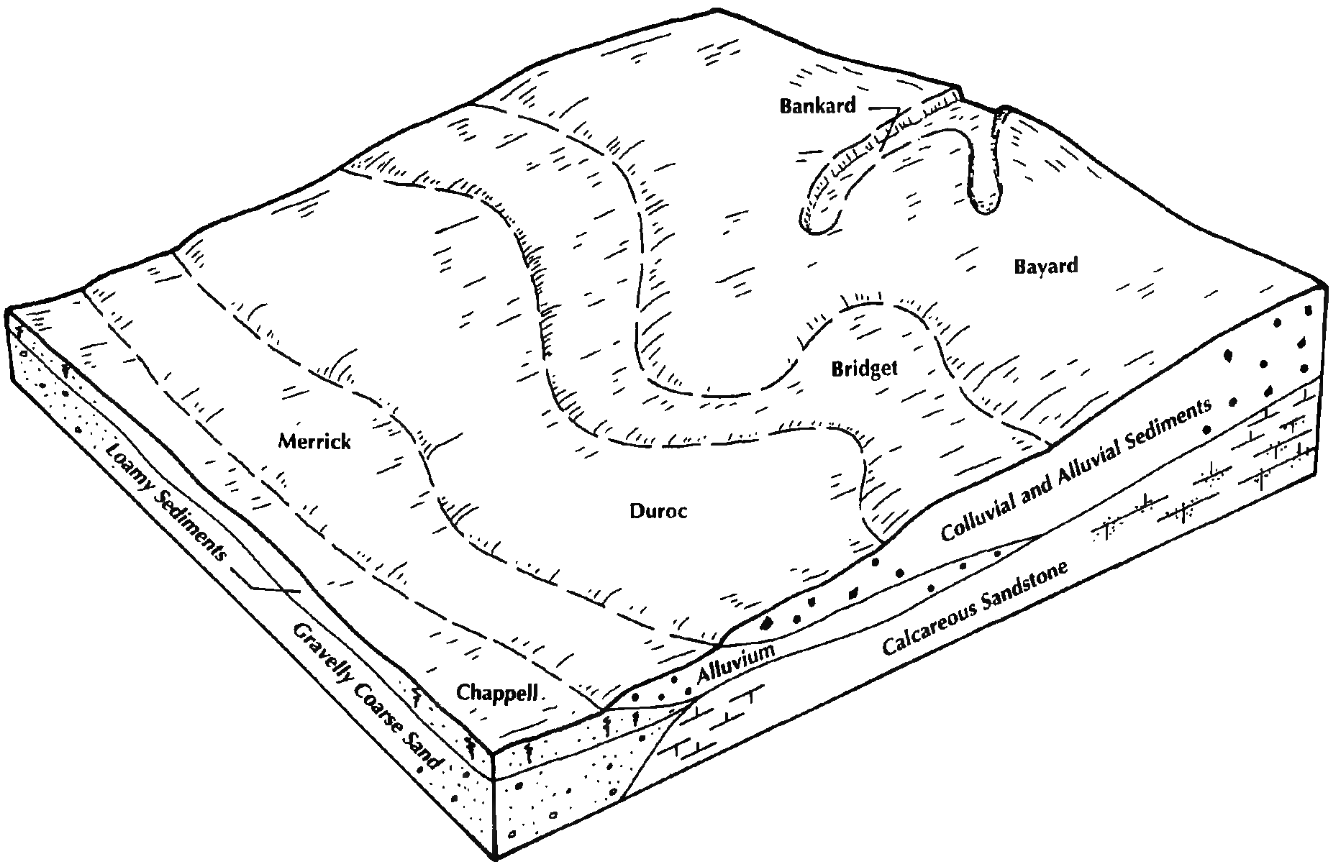

Figure 8.—Typical pattern of soils and parent material in the Bayard-Duroc-Bridget association.

brown, calcareous loam. The underlying material to a depth of more than 60 inches is very pale brown and light gray loam.

Of minor extent in this association are Duroc, Lodgepole, and Rosebud soils. Duroc soils have dark colors below a depth of 20 inches. They are in landscape positions slightly lower than those of the Satanta and Kuma soils. Lodgepole soils are somewhat poorly drained. They are in potholes. Rosebud soils are moderately deep over bedrock. They are in landscape positions similar to those of the Satanta soils.

The major soils in this association are used for diversified farming. Most farms combine grain and livestock enterprises. Most areas are dry-farmed. Winter wheat is the principal crop. A few small areas are irrigated. Wheat, beans, and corn are grown in these areas.

Water erosion, soil blowing, and drought are hazards. A system of conservation tillage that leaves crop residue on the surface helps to control soil blowing and water erosion and conserve moisture. Summer fallowing can help to increase the moisture supply needed for winter wheat.

8. Bayard-Duroc-Bridget Association

Very deep, nearly level to gently sloping, well drained, loamy and silty soils that formed in colluvium and alluvium; on stream terraces

This association consists mainly of soils in long areas on stream terraces that are parallel to the rivers. Slopes range from 0 to 3 percent.

This association has a total area of about 45,440 acres, or about 6 percent of the county. It is about 43 percent Bayard soils, 27 percent Duroc soils, 15 percent Bridget soils, and 15 percent minor soils (fig. 8).

Bayard soils are on very gently sloping high stream terraces. Typically, the surface soil is dark grayish brown and grayish brown, friable very fine sandy loam about 16 inches thick. Next is a transitional layer of pale brown, friable very fine sandy loam about 8 inches thick. The underlying material to a depth of more than

60 inches is pale brown and very pale brown very fine sandy loam and loamy very fine sand.

Duroc soils are on nearly level and very gently sloping stream terraces. Typically, the surface layer is grayish brown, friable loam about 7 inches thick. The subsoil is about 37 inches thick. It is grayish brown, friable loam in the upper part, dark grayish brown loam in the next part, and brown silt loam in the lower part. The underlying material to a depth of more than 60 inches is light gray, calcareous silt loam.

Bridget soils are on nearly level and very gently sloping high stream terraces. Typically, the surface layer is grayish brown, friable silt loam about 6 inches thick. The subsurface layer is dark grayish brown, friable silt loam about 6 inches thick. Next is a transitional layer of pale brown silt loam about 8 inches thick. The underlying material to a depth of more than 60 inches is very pale brown silt loam.

Of minor extent in this association are Bankard, Chappell, and Merrick soils. Bankard soils are sandy. They are somewhat excessively drained. They are in drainageways that drain upland areas. Chappell soils have gravelly coarse sand at a depth of 20 to 40 inches. They are in landscape positions slightly lower than those of the Bayard, Duroc, and Bridget soils. Merrick soils have more clay in the subsoil than the Bayard, Duroc, and Bridget soils. They are moderately well drained. They are on high bottom land.

The major soils in this association are used for diversified farming. Most farms combine grain and livestock enterprises. The principal crops are dry, edible beans and corn. Most areas are farmed, and most of these areas are irrigated. Irrigation is mainly provided by furrow or gravity systems. Irrigation in some areas is provided by sprinkler systems.

Soil blowing is a hazard. Leaving crop residue on the surface during the winter can help to control soil blowing. The main management concerns in irrigated areas are providing an adequate amount of water and controlling runoff.

9. Janise-Boel-Lawet Association

Very deep, nearly level, moderately well drained to poorly drained, loamy and sandy soils that formed in alluvium; on high bottom land

This association consists mainly of soils on high bottom land along the north side of the North Platte River. Slopes range from 0 to 2 percent.

This association has a total area of about 11,030 acres, or about 2 percent of the county. It is about 43 percent Janise soils, 33 percent Boel soils, 20 percent Lawet soils, and 4 percent minor soils.

Janise soils are on high bottom land. They are somewhat poorly drained and moderately well drained. Typically, the surface layer is gray, very friable, calcareous loam about 3 inches thick. The subsurface layer is grayish brown, very friable, calcareous loam about 5 inches thick. Next is a transitional layer of light brownish gray, calcareous loam about 6 inches thick. The underlying material extends to a depth of 60 inches or more. It is light gray and white, calcareous loam in the upper part, light gray and light brownish gray, calcareous very fine sandy loam and loamy very fine sand in the next part, and pale brown, calcareous coarse sand in the lower part. The soil is moderately alkaline or strongly alkaline at a depth of 0 to 8 inches. The soil is very strongly alkaline below a depth of 8 inches.

Boel soils are on high bottom land. They are somewhat poorly drained. Typically, the surface layer is dark grayish brown, soft loamy fine sand about 13 inches thick. Next is a transitional layer of grayish brown, soft loamy fine sand about 3 inches thick. The underlying material to a depth of more than 60 inches is stratified brown, pale brown, light brownish gray, and light gray, calcareous, loamy fine sand and fine sand. It has dark yellowish brown mottles in the upper part.

Lawet soils are on high bottom land. They are poorly drained. Typically, the surface layer is gray, friable, calcareous loam about 10 inches thick. The subsurface layer is gray, friable, calcareous, sandy clay loam about 10 inches thick. The layer of accumulated lime is gray, friable, calcareous, sandy clay loam about 6 inches thick. The underlying material to a depth of 60 inches or more is gray and light brownish gray, calcareous, sandy clay loam.

Of minor extent in the association are the Ipage soils. Ipage soils are moderately well drained. They are in landscape positions slightly higher than those of the Janise, Boel, and Lawet soils.

Ranches in this association are mainly cow-calf livestock enterprises. Most areas are mowed for hay or are used for winter pasture. In some small areas irrigation is provided by center-pivot systems. Alfalfa and grasses are the principal crops.

The main management concern is maintaining or improving desirable grasses through proper grazing use, proper mowing heights, and timely mowing.

10. Lex-Norwest-Alda Association

Very deep, nearly level, somewhat poorly drained, loamy soils that are underlain by gravelly coarse sand and coarse sand and loamy soils that formed in alluvium; on bottom land

This association consists mainly of soils on bottom land along the North Platte and South Platte Rivers.

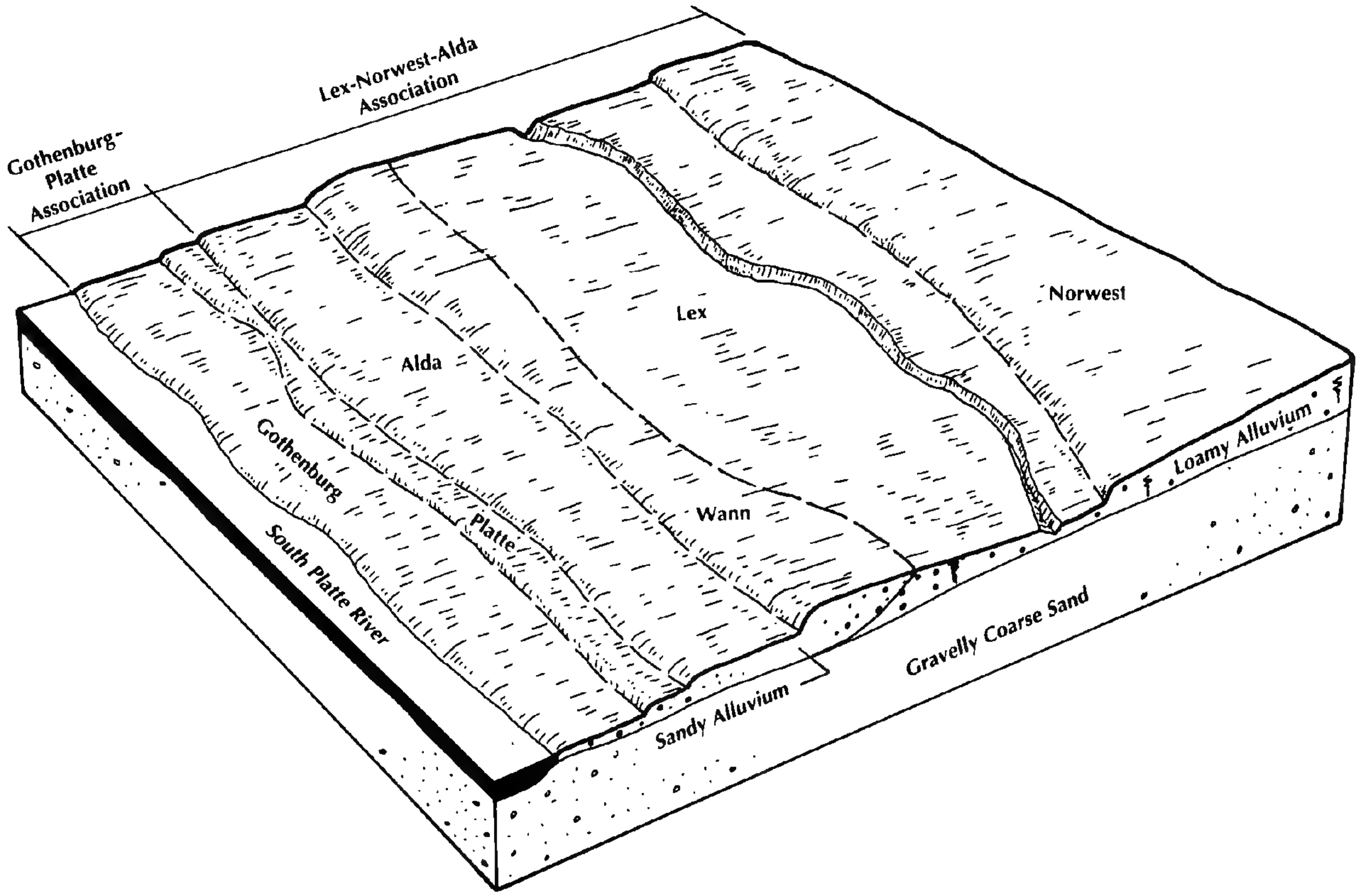

Figure 9.—Typical pattern of soils and parent material in the Lex-Norwest-Alda and Gothenburg-Platte associations.

Slopes range from 0 to 2 percent.

This association has a total area of about 20,390 acres, or about 3 percent of the county. It is about 34 percent Lex soils, 26 percent Norwest soils, 21 percent Alda soils, and 19 percent minor soils (fig. 9).

Lex soils are in low areas on the bottom land. Typically, the surface soil is gray, friable, calcareous loam about 11 inches thick. Next is a transitional layer of gray, calcareous, silty clay loam about 8 inches thick. The underlying material extends to a depth of more than 60 inches. It is gray fine sandy loam in the upper part and light gray gravelly sand in the lower part.

Norwest soils are on bottom land. Typically, the surface layer is dark gray, friable, calcareous loam about 7 inches thick. The subsurface layer is dark gray and gray, friable, calcareous loam about 8 inches thick. The subsoil is light gray, calcareous loam about 19 inches thick. The underlying material extends to a depth of more than 60 inches. It is mottled, calcareous very fine sandy loam in the upper part and stratified, mottled, calcareous clay loam and loamy sand in the lower part.

Alda soils are on bottom land. Typically, the surface layer is gray, friable fine sandy loam about 9 inches thick. The subsurface layer is grayish brown, friable fine sandy loam about 8 inches thick. Next is a transitional layer of brown sandy loam about 7 inches thick. The underlying material extends to a depth of about 60 inches. It is brown sandy loam in the upper part and very pale brown coarse sand in the lower part.

Of minor extent in this association are Platte and Wann soils. Platte and Wann soils are on bottom land. They are somewhat poorly drained. Platte soils have coarse material above a depth of 20 inches. Wann soils do not have coarse material above a depth of 40 inches.

The major soils in this association are used for diversified farming. Most farms combine grain and livestock enterprises. Corn, beans, and winter wheat

are the main crops. Most areas are farmed, and most of these areas are irrigated. Irrigation is mainly provided by gravity systems.

The flooding, soil blowing, and wetness are limitations. A system of conservation tillage that leaves crop residue on the surface helps to control soil blowing.

11. Gothenburg-Platte Association

Very deep, nearly level, somewhat poorly drained and poorly drained sandy and loamy soils that are less than 20 inches thick over gravelly coarse sand and that formed in gravelly alluvium; on bottom land

This association consists of soils on bottom land along the North Platte and South Platte Rivers. It is in low areas on the bottom land and is commonly next to or very close to the rivers. Slopes range from 0 to 2 percent.

This association has a total area of about 14,910 acres, or about 2 percent of the county. It is about 78 percent Gothenburg soils, 9 percent Platte soils, and 13 percent minor soils (fig. 9).

Gothenburg soils are poorly drained and are subject to occasional flooding. Typically, the surface layer is grayish brown, very friable loamy sand about 3 inches thick. The underlying material extends to a depth of more than 60 inches. It is grayish brown, very friable sand in the upper part and light brownish gray gravelly coarse sand in the lower part.

Platte soils are somewhat poorly drained and are subject to occasional flooding. Typically, the surface layer is dark gray, friable loam about 5 inches thick. Next is a transitional layer of light brownish gray, friable fine sandy loam about 6 inches thick. The underlying material extends to a depth of more than 60 inches. It is pale brown, very friable fine sandy loam in the upper part and gravelly coarse sand in the lower part.

Of minor extent in this association are Bankard soils and areas of Fluvaquents, sandy, and Pits and dumps. Bankard soils are somewhat excessively drained and are subject to rare flooding. Fluvaquents, sandy, are very poorly drained and are subject to frequent flooding.

Farms in this association are diversified. The portion of the farms that is in this association is in pasture or range and is used for livestock grazing. Livestock wells generally can be easily established in areas of this association.

The flooding and wetness are hazards. In years when flooding is a serious hazard, livestock may need to be moved to higher ground.

Detailed Soil Map Units

The map units on the detailed soil maps at the back of this survey represent the soils in the survey area. The map unit descriptions in this section, along with the soil maps, can be used to determine the suitability and potential of a soil for specific uses. They also can be used to plan the management needed for those uses. More information on each map unit, or soil, is given under the heading "Use and Management of the Soils."

Each map unit on the detailed soil maps represents an area on the landscape and consists of one or more soils for which the unit is named.

A symbol identifying the soil precedes the map unit name in the soil descriptions. Each description includes general facts about the soil and gives the principal hazards and limitations to be considered in planning for specific uses.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer or of the underlying material, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer or of the underlying material. They also can differ in slope, stoniness, salinity, wetness, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Valent fine sand, 3 to 9 percent slopes, is a phase of the Valent series.

Some map units are made up of two or more major soils. These map units are called soil complexes. A *soil complex* consists of two or more soils, or one or more soils and a miscellaneous area, in such an intricate pattern or in such small areas that they cannot be shown separately on the soil maps. The pattern and proportion of the soils are somewhat similar in all areas. Sully-McConaughy complex, 9 to 30 percent slopes, is an example.

Most map units include small scattered areas of soils other than those for which the map unit is named. Some of these included soils have properties that differ substantially from those of the major soil or soils. Such differences could significantly affect use and management of the soils in the map unit. The included soils are identified in each map unit description. Some small areas of strongly contrasting soils are identified by a special symbol on the soil maps.

This survey includes *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Pits and dumps is an example. Miscellaneous areas are shown on the soil maps. Some that are too small to be shown are identified by a special symbol on the soil maps.

Table 4 gives the acreage and proportionate extent of each map unit. Other tables (see "Summary of Tables") give properties of the soils and the limitations, capabilities, and potentials for many uses. The "Glossary" defines many of the terms used in describing the soils.

Soil Descriptions

Ad—Alda fine sandy loam, 0 to 2 percent slopes. This very deep, nearly level, somewhat poorly drained soil is on bottom land. It formed in 20 to 40 inches of loamy alluvium over coarse sand. It is occasionally flooded. Areas are commonly long and parallel to the rivers. They range from 5 to 150 acres in size.

Typically, the surface layer is gray, calcareous, friable fine sandy loam about 9 inches thick. The subsurface layer is grayish brown, friable fine sandy loam about 8 inches thick. Next is a transitional layer of brown, very friable sandy loam about 7 inches thick. The underlying material extends to a depth of about 60 inches. It is brown sandy loam in the upper part and very pale brown coarse sand in the lower part. In some areas the upper part of the profile contains more clay.

Included with this soil in mapping are small areas of Lex and Wann soils. Lex soils have more clay in the control section than the Alda soil. Wann soils do not have coarse material above a depth of 40 inches. The included soils are in landscape positions similar to those of the Alda soil. They make up less than 10 percent of the map unit.

Permeability is moderately rapid in the upper part of the Alda soil and very rapid in the lower part. The available water capacity is low. Runoff is slow. The organic matter content is moderate. The water intake rate is moderately high. The seasonal high water table ranges from a depth of about 2 feet during wet years to about 3 feet during dry years.

Most of the acreage of this soil is used for cultivated crops. Some areas are irrigated if water is available. A few areas are used as pasture or range.

If dry-farmed, this soil is suited to wheat, corn, and alfalfa. The flooding is a hazard. Constructing dams, dikes, and diversion terraces helps to control flooding. Soil blowing is a hazard in areas where the surface is not adequately protected by crops or crop residue. Wetness is a limitation. It sometimes delays tilling and planting in the spring. A system of conservation tillage, such as disking or chiseling, that leaves crop residue on the surface helps to control soil blowing. Returning crop residue to the soil helps to improve and maintain organic matter content, fertility, and tilth and increases the rate of water infiltration.

If irrigated, this soil is suited to corn and alfalfa. The flooding is a hazard. Constructing dams, dikes, and diversion terraces helps to control flooding. Soil blowing is a hazard in areas where the surface is not adequately protected by crops or crop residue. The wetness often delays tillage and cultivation early in the spring. A system of conservation tillage, such as disking or chiseling, that leaves crop residue on the surface helps to control soil blowing. Returning crop residue to the soil helps to improve and maintain organic matter content, fertility, and tilth and increases the rate of water infiltration.

This soil is suited to range and native hay. Continuous heavy grazing or improper haying methods reduce the amount of protective cover and the quality of native plants. Overgrazing when the soil is wet can result in surface compaction and the formation of small mounds, which make grazing and harvesting hay difficult. Proper grazing use, timely deferment of grazing and haying, and restricted use during wet periods help to keep the native plants in good condition.

This soil is suited to the trees and shrubs grown as windbreaks and to plantings that enhance recreational areas and wildlife habitat. Trees and shrubs that can withstand the wetness survive and grow well. Weeds and undesirable grasses that compete with the trees for moisture, a lack of seasonal rainfall, and soil blowing that damages seedlings are limitations. The weeds and undesirable grasses can be controlled by timely cultivation or by applications of the appropriate herbicide. Irrigation can provide the moisture needed during dry periods. Soil blowing can be controlled by planting a cover crop between the tree rows.

This soil is not suited to septic tank absorption fields because of the flooding, the wetness, and a poor filtering capacity. A suitable alternative site should be selected. The sides of shallow excavations can cave in unless they are shored. Shoring should be completed during dry periods. The soil is not suited to dwellings because of the flooding. A suitable alternative site should be selected. Constructing roads on suitable, well compacted fill material above the flood level, providing adequate roadside ditches, and installing culverts help to prevent the road damage caused by flooding and wetness. The damage to roads caused by frost action can be minimized by a good surface drainage system and by a gravel moisture barrier in the subgrade. Crowning the road by grading and constructing adequate roadside ditches help to provide the needed surface drainage.

The capability units are IIIw-6, dryland, and IIIw-9, irrigated; Subirrigated range site; windbreak suitability group 2S.

AwF—Altvan-Dix complex, 6 to 30 percent slopes. These very deep, well drained and excessively drained, strongly sloping to steep soils are on uplands. The well drained Altvan soil formed in 20 to 40 inches of loamy material over gravelly coarse sand. The excessively drained Dix soil formed in 4 to 10 inches of loamy and sandy material over very gravelly coarse sand. The Altvan soil is on side slopes that are typically less than 15 percent and in plane or concave positions on the landscape. The Dix soil is on narrow ridgetops and convex slopes. Areas range from 10 to 100 acres in size. They are about 50 to 70 percent Altvan soil and about 20 to 40 percent Dix soil. These two soils occur as areas so intricately mixed or so small in size that separating them in mapping is not practical.

Typically, the Altvan soil has a surface soil of brown, friable loam about 5 inches thick. The subsoil is about 29 inches thick. The upper part is brown, firm loam, the next part is pale brown, friable loam, and the lower part is light brownish gray, calcareous loam. The underlying material is very pale brown, loose, gravelly coarse sand. In some areas the depth to gravelly coarse sand is less than 20 inches.

Typically, the Dix soil has a surface soil of brown, very friable gravelly loam about 4 inches thick. The underlying material is light yellowish brown, loose, very gravelly coarse sand. In some areas the underlying material is calcareous.

Included with these soils in mapping are Satanta soils and areas of rock outcrop. Satanta soils do not have coarse material above a depth of 60 inches. They are slightly higher on the landscape than the Altvan and

Dix soils. The areas of rock outcrop are on ledges that are lower on the landscape than the Altvan and Dix soils. Inclusions make up 5 to 15 percent of the map unit.

Permeability is moderate in the solum of the Altvan soil and very rapid in the underlying material. It is very rapid in the underlying material of the Dix soil. The available water capacity is moderate in the Altvan soil and very low in the Dix soil. Runoff is rapid on both soils. The organic matter content is moderately low.

Most of the acreage of these soils supports native grasses and is used as range. The soils are not suited to cultivated crops because of droughtiness in areas of the Dix soil and the slope.

If these soils are used as range or hayland, the climax vegetation is dominantly big bluestem, blue grama, little bluestem, sideoats grama, sand bluestem, and western wheatgrass. These species make up 70 percent or more of the total annual forage. Buffalograss, needleandthread, sedges, and forbs make up the rest. If subject to continuous heavy grazing, big bluestem and little bluestem decrease in abundance and are replaced by blue grama, buffalograss, needleandthread, sand dropseed, western wheatgrass, and forbs. If overgrazing continues for many years, the native grasses lose vigor and are unable to stabilize the site. As a result, water erosion and soil blowing are excessive.

If the range is in excellent condition, the suggested initial stocking rate is 0.7 animal unit month per acre on the Altvan soil and 0.4 animal unit month per acre on the Dix soil. A planned grazing system that includes proper grazing use and timely deferment of grazing and haying helps to maintain or improve the range condition. Properly located fences and livestock watering and salting facilities can result in a more uniform distribution of grazing. Areas previously used as cropland should be reseeded to a suitable grass mixture if they are used as range. In areas where gullies have formed because of severe water erosion, land shaping or other mechanical practices may be needed to smooth and stabilize the site before it is reseeded.

If these soils are used as hayland, the forage should be harvested only every other year. During the year the forage is not harvested, the hayland should be used only as fall or winter range. Mowing should be regulated so that the grasses remain vigorous and healthy.

These soils generally are unsuited to the trees and shrubs grown as windbreaks. The slope prevents the use of conventional tree-planting and tillage equipment. A few areas can support the trees and shrubs that enhance wildlife habitat if suitable species are planted by hand or if other special management is applied.

These soils generally are not suited to sanitary facilities because of the slope. A suitable alternative site should be selected. These soils readily absorb but do not adequately filter the effluent in septic tank absorption fields. The poor filtering capacity can result in pollution of underground water supplies. The sides of shallow excavations can cave in unless they are shored. Dwellings should be designed so that they conform to the natural slope of the land, or building sites should be graded to a suitable gradient. Cutting and filling can provide a suitable grade for roads. The damage to roads caused by frost action can be minimized by a good surface drainage system. Crowning the road by grading and constructing adequate roadside ditches help to provide the needed surface drainage.

The capability unit is VIe-3, dryland; windbreak suitability group 10. The Altvan soil is in the Silty range site, and the Dix soil is in the Shallow to Gravel range site.

Bb—Bankard sand, 0 to 2 percent slopes. This very deep, nearly level, somewhat excessively drained soil is on bottom land. It formed in sandy alluvium. It is subject to rare flooding. This map unit starts at the Keystone diversion dam and extends downstream for several miles. The water table is lower than it originally was because of scouring of the North Platte River channel. Areas are commonly long and parallel to the river. They range from 50 to several hundred acres in size.

Typically, the surface layer is grayish brown, very friable sand about 4 inches thick. The underlying material to a depth of more than 60 inches is pale brown sand and coarse sand. In some areas loamy sand, coarse sand, or gravelly sand is at the surface.

Included with this soil in mapping are small areas of Alda, Gothenburg, and Platte soils. Alda soils have more silt and clay in the control section than the Bankard soil. They have coarse sand at a depth of 20 to 40 inches. Alda soils are slightly above the Bankard soil. Alda and Platte soils have a mollic epipedon. Platte soils have gravelly coarse sand at a depth of 10 to 20 inches. Gothenburg soils are poorly drained. They are slightly lower on the landscape than the Bankard soil.

Permeability is very rapid in the surface layer of the Bankard soil and rapid in the underlying material. The available water capacity is low. Runoff is slow. The organic matter content is low.

All of the acreage of this soil supports grasses, weeds, shrubs, and sedges interspersed with cottonwood, cedar, and willow trees. Because of droughtiness, most of the trees are dying.

If this soil is used as range, the climax vegetation is dominantly blue grama, switchgrass, needleandthread, prairie sandreed, and sand bluestem. These species

make up 55 percent or more of the total annual forage. Sand dropseed, sand sagebrush, western wheatgrass, sedges, and forbs make up the rest. If subject to continuous heavy grazing, sand bluestem, little bluestem, and prairie sandreed decrease in abundance and are replaced by blue grama, sand dropseed, needleandthread, sedges, and forbs. If overgrazing continues for many years, blue grama, sedges, common pricklypear, brittle pricklypear, fringed sagewort, and other forbs dominate the site.

If the range is in excellent condition, the suggested initial stocking rate is 0.4 animal unit month per acre. A planned grazing system that includes proper grazing use and timely deferment of grazing helps to maintain or improve the range condition. A planned, short period of heavy grazing during the grazing season or deferment of grazing in 2 out of 3 years helps to keep little bluestem and prairie sandreed in the plant community. Properly located fences and livestock watering and salting facilities can result in a more uniform distribution of grazing. The low available water capacity and droughtiness are limitations. The amount of forage produced depends on the frequency and amount of seasonal rainfall.

This soil generally is unsuited to the trees and shrubs grown as windbreaks. Some small areas are suitable sites for planting trees; however, onsite investigation is needed.

This soil readily absorbs but does not adequately filter the effluent in septic tank absorption fields. The poor filtering capacity can result in pollution of underground water supplies. The sides of shallow excavations can cave in unless they are shored. In places sand and gravel can be excavated and used for construction purposes. Constructing dwellings and buildings on raised, well compacted fill material helps to prevent the damage caused by flooding. Constructing roads on suitable, well compacted fill material above the flood level, providing adequate roadside ditches, and installing culverts help to prevent the damage caused by flooding.

The capability unit is VIs-3, dryland; Shallow to Gravel range site; windbreak suitability group 10.

Bc—Bankard loamy sand, 0 to 2 percent slopes. This very deep, nearly level, somewhat excessively drained soil is on flood plains that fan out on stream terraces. It formed in sandy alluvium. It is subject to rare flooding. Areas range from 5 to 50 acres in size.

Typically, the surface layer is brown, very friable loamy sand about 8 inches thick. The underlying material to a depth of more than 60 inches is stratified, pale brown, loose, calcareous gravelly sand and loamy very fine sand.

Included with this soil in mapping are small areas of Bayard soils. These soils have less sand in the control section than the Bankard soil. They have a mollic epipedon. They are in landscape positions slightly below those of the Bankard soil. They make up 5 to 15 percent of the map unit.

Permeability is rapid in the Bankard soil, and the available water capacity is low. Runoff is slow. The organic matter content is moderately low. The water intake rate is very high.

Most of the acreage of this soil is used as cropland. Some areas are irrigated if water is available. A few areas are used as pasture or range.

If dry-farmed, this soil is poorly suited to all crops. Drought and soil blowing are hazards. The low available water capacity and low fertility are limitations. A system of conservation tillage, such as disking or chiseling, that leaves crop residue on the surface helps to control soil blowing. Returning crop residue to the soil and applying barnyard manure help to improve and maintain organic matter content, fertility, and tilth.

If irrigated, this soil is poorly suited to all crops because of the low available water capacity and low fertility. Also, soil blowing can be a hazard. A system of conservation tillage, such as disking or chiseling, that leaves crop residue on the surface helps to control soil blowing. Efficiently managing irrigation water is needed to prevent overirrigation and the loss of plant nutrients. Because of the very high rate of water intake, this soil is best suited to sprinkler irrigation.

This soil is suited to range and native hay. A cover of range plants is effective in controlling soil blowing. Overgrazing or improper haying methods reduce the amount of protective cover and the quality of native plants. Proper grazing use, timely deferment of grazing and haying, and a planned grazing system help to keep the native plants in good condition.

This soil is suited to the trees and shrubs grown as windbreaks and to plantings that enhance recreational areas and wildlife habitat. The survival and growth rates of adapted species are fair. The lack of seasonal rainfall and soil blowing are hazards. Soil blowing can be controlled by maintaining strips of sod or cover crops between the tree rows. Irrigation can provide the moisture needed during dry periods. Hoeing by hand, rototilling, and applying the appropriate herbicide help to control plant competition in the tree rows.

This soil readily absorbs but does not adequately filter the effluent in septic tank absorption fields. The poor filtering capacity can result in pollution of underground water supplies. The sides of shallow excavations can cave in unless they are shored. Constructing dwellings on raised, well compacted fill material helps to prevent the damage caused by

flooding. Constructing roads on suitable, well compacted fill material above the flood level, providing adequate roadside ditches, and installing culverts help to prevent the road damage caused by flooding.

The capability units are IVe-5, dryland, and IVe-11, irrigated; Sandy Lowland range site; windbreak suitability group 7.

Bd—Bankard loamy sand, channeled. This very deep, somewhat excessively drained soil is on flood plains. It formed in sandy alluvium. It is dissected by meandering channels that are 30 to 80 feet wide and as much as 4 feet deep. It is frequently flooded. Slopes are mainly less than 3 percent but are as much as 6 percent on some narrow benches and streambanks. Areas range from 5 to 50 acres in size.

Typically, the surface layer is brown, very friable loamy sand about 6 inches thick. The underlying material extends to a depth of more than 60 inches. It is pale brown, stratified, calcareous sand that has thin lenses of loamy fine sand in the upper part and very pale brown, loose gravelly sand in the lower part. It has thin strata of loamy material.

Included with this soil in mapping are small areas of the Bayard soils. These soils have less sand in the control section than the Bankard soil. They have a mollic epipedon. They are in landscape positions slightly lower than those of the Bankard soil. Some areas of the Bayard soils are covered with sand and gravel and do not support vegetation. Included areas make up 5 to 15 percent of the map unit.

Permeability is rapid in the Bankard soil, and the available water capacity is low. Runoff is slow. The organic matter content is low.

Nearly all of the acreage of this soil is used as range. The soil is unsuited to farming because of the flooding and the droughtiness. The droughtiness is a result of the low available water capacity.

If this soil is used as range, the climax vegetation is dominantly blue grama, switchgrass, needleandthread, prairie sandreed, and sand bluestem. These species make up 55 percent or more of the total annual forage. Sand dropseed, sand sagebrush, western wheatgrass, sedges, and forbs make up the rest. If subject to continuous heavy grazing, sand bluestem, little bluestem, and prairie sandreed decrease in abundance and are replaced by blue grama, sand dropseed, needleandthread, sedges, and forbs. If overgrazing continues for many years, blue grama, sedges, common pricklypear, brittle pricklypear, fringed sagewort, and other forbs dominate the site.

If the range is in excellent condition, the suggested initial stocking rate is 0.4 animal unit month per acre. A planned grazing system that includes proper grazing use and timely deferment of grazing helps to maintain or improve the range condition. A planned, short period of heavy grazing during the grazing season or deferment of grazing in 2 out of 3 years helps to keep little bluestem and prairie sandreed in the plant community. Properly located fences and livestock watering and salting facilities can result in a more uniform distribution of grazing. The low available water capacity and droughtiness are limitations. The amount of forage produced depends on the frequency and amount of seasonal rainfall. Areas previously used as cropland should be reseeded to a suitable grass mixture if they are used as range.

This soil generally is unsuited to the trees and shrubs grown as windbreaks. Some small areas are suitable sites for planting trees; however, onsite investigation is needed.

This soil is not suited to septic tank absorption fields because of the flooding. A suitable alternative site should be selected. The soil readily absorbs but does not adequately filter the effluent in septic tank absorption fields. The poor filtering capacity can result in pollution of underground water supplies. The soil is not suited to dwellings because of the flooding. A suitable alternative site should be selected. Constructing roads on suitable, well compacted fill material above the flood level, providing adequate roadside ditches, and installing culverts help to prevent the road damage caused by flooding.

The capability unit is VIw-7, dryland; Shallow to Gravel range site; windbreak suitability group 10.

BeB—Bayard very fine sandy loam, 1 to 3 percent slopes. This very deep, very gently sloping, well drained soil is on stream terraces. It formed in colluvial and alluvial sediments. Areas range from 5 to 150 acres in size.

Typically, the surface layer is dark grayish brown, very friable very fine sandy loam about 9 inches thick. The subsurface layer is grayish brown, very friable very fine sandy loam about 7 inches thick. Next is a transitional layer of pale brown, very friable very fine sandy loam about 8 inches thick. The underlying material extends to a depth of more than 60 inches. It is pale brown very fine sandy loam in the upper part and very pale brown loamy very fine sand in the lower part.

Included with this soil in mapping are small areas of Bankard and Bridget soils. Bankard soils have more sand in the control section than the Bayard soil. They do not have a mollic epipedon. They are in landscape positions slightly higher than those of the Bayard soil. Bridget soils have less sand in the control section than the Bayard soil. Also, they are lower on the landscape. Included soils make up 5 to 15 percent of the map unit.

Permeability is moderately rapid in the Bayard soil, and the available water capacity is moderate. Runoff is slow. The organic matter content is moderate. The water intake rate is moderately high.

Most of the acreage of this soil is used as cropland. Some areas are irrigated if water is available. A few areas are used as pasture or range.

If dry-farmed, this soil is suited to winter wheat. Water erosion and soil blowing are moderate hazards in areas where the surface is not adequately protected by crops, crop residue, or terraces. Cover crops and a system of conservation tillage that leaves crop residue on the surface help to control soil blowing and conserve moisture. Stripcropping also helps to control soil blowing. Returning crop residue to the soil increases the content of organic matter, improves fertility, and helps to maintain tilth. Channel terraces minimize the amount of water lost during periods of heavy rainfall and help to keep moisture on the fields for crops.

If irrigated, this soil is suited to corn; dry, edible beans; and alfalfa. Land leveling increases the efficiency of gravity irrigation systems. Sprinkler irrigation is an efficient method of irrigation. Soil blowing is a slight hazard when crops are planted. Winter cover crops help to control soil blowing. Terraces minimize the amount of water lost during periods of heavy rainfall. A system of conservation tillage, such as disking, chiseling, no-till plant, or till plant, that leaves crop residue on the surface helps to control soil blowing and conserve moisture. Planting green manure crops and leaving crop residue on the soil improve tilth and organic matter content and increase the rate of water infiltration, especially if the soil has been disturbed by land leveling.

This soil is suited to range and native hay. A cover of range plants is effective in controlling soil blowing. Overgrazing or improper haying methods reduce the amount of protective cover and the quality of native plants. As a result, soil blowing is excessive and small blowouts can form. Proper grazing use, timely deferment of grazing and haying, and a planned grazing system help to keep the native plants in good condition.

This soil is suited to the trees and shrubs grown as windbreaks and to plantings that enhance recreational areas and wildlife habitat. The survival and growth rates of adapted species are fair. The lack of seasonal rainfall and soil blowing are hazards. Soil blowing can be controlled by maintaining strips of sod or cover crops between the tree rows. Irrigation can provide the moisture needed during dry periods. Hoeing by hand, rototilling, and applying the appropriate herbicide help to control plant competition in the tree rows.

This soil generally is suited to septic tank absorption fields and dwellings. The sides of shallow excavations can cave in unless they are shored. The damage to roads caused by frost action can be minimized by a good surface drainage system. Crowning the road by grading and constructing adequate roadside ditches help to provide the needed surface drainage.

The capability units are IIe-3, dryland, and IIe-8, irrigated; Sandy range site; windbreak suitability group 5.

Bo—Boel loamy fine sand, 0 to 2 percent slopes. This deep, nearly level, somewhat poorly drained soil is on high bottom land that is along the North Platte River downstream from the sandhills. It formed in sandy alluvium. It is subject to rare flooding. Most areas are irregular in shape and range from 5 to 100 acres in size.

Typically, the surface layer is dark grayish brown, soft loamy fine sand about 13 inches thick. The subsurface layer is grayish brown, soft loamy fine sand about 3 inches thick. Next is a transitional layer of brown, calcareous, soft loamy fine sand about 10 inches thick. The underlying material to a depth of more than 60 inches is stratified pale brown, light brownish gray, and light gray loamy fine sand and fine sand. It has dark yellowish brown mottles in the upper part. In a few places the dark colors of the surface layer are more than 30 inches thick.

Included with this soil in mapping are small areas of Ipage and Lawet soils. Ipage soils are moderately well drained. They do not have a mollic epipedon. They are on stream terraces above the Boel soil. Lawet soils have less sand and more silt in the control section than the Boel soil. They are in the lower, poorly drained depressions on the bottom land. Included soils make up 5 to 15 percent of the map unit.

Permeability is rapid in the Boel soil, and the available water capacity is low. Runoff is very slow. The organic matter content is moderately low. The water intake rate is very high. The seasonal high water table ranges from a depth of about 1.5 feet during wet years to about 3.5 feet during dry years.

Most of the acreage of this soil supports native grasses and is used as range or hayland. Some small areas are irrigated with sprinkler irrigation systems. Corn and alfalfa are the principal crops in these areas.

If dry-farmed, this soil is poorly suited to corn, small grain, and introduced grasses. Flooding is a hazard. It delays planting in the spring and limits the production of small grain. Alfalfa is suited to areas where the water table is not too high. This soil may be difficult to work in spring because of the wetness caused by the high water table. Planting alfalfa and other close-growing crops eliminates the need for tilling the soil in the spring and helps to control soil blowing during dry periods. A

system of conservation tillage that leaves crop residue on the surface helps to control soil blowing. Returning crop residue to the soil and applying barnyard manure helps to improve and maintain the organic matter content and fertility.

This soil is poorly suited to irrigated crops. If the flooding is controlled, corn and alfalfa are suitable irrigated crops. This soil is best suited to sprinkler irrigation systems because frequent, light applications of water are needed. Fertilizers can be leached below the root zone because of excessive irrigation. Using open drains or tile drains in areas where suitable outlets are available can help reduce wetness. Winter cover crops help to control soil blowing.

If this soil is used as range or hayland, the climax vegetation is dominantly big bluestem, little bluestem, indiangrass, switchgrass, and sedges. These species make up 75 percent or more of the total annual forage. Prairie cordgrass and forbs make up the rest. If subject to continuous heavy grazing or improperly harvested for hay, big bluestem, little bluestem, indiangrass, switchgrass, and prairie cordgrass decrease in abundance and are replaced by western wheatgrass, slender wheatgrass, green muhly, sedges, and rushes. If overgrazing or improper haying methods continue for many years, sedges, rushes, and forbs dominate the site.

If the range is in excellent condition, the suggested initial stocking rate is 1.6 animal unit months per acre. A planned grazing system that includes proper grazing use, timely deferment of grazing and haying, and restricted use during wet periods helps to maintain or improve the range condition. This soil is generally the first to be overgrazed when it is in a pasture that includes better drained, sandy soils. Properly located fences and livestock watering and salting facilities result in a more uniform distribution of grazing. Areas previously used as cropland should be reseeded to a suitable grass mixture if they are used as range.

If this soil is used as hayland, mowing should be regulated so that the grasses remain vigorous. The hay is of best quality when the grasses are cut early. After the ground is frozen, livestock can graze without damaging the meadows. They should be removed in spring, before the ground thaws.

This soil is suited to the trees and shrubs grown as windbreaks and to plantings that enhance recreational areas and wildlife habitat. Trees and shrubs that can withstand the occasional wetness survive and grow well. Weeds and undesirable grasses that compete with the trees for moisture, a lack of seasonal rainfall, and soil blowing that damages seedlings are limitations. The weeds and undesirable grasses can be controlled by timely cultivation or by applications of the appropriate herbicide. Irrigation can provide the moisture needed during dry periods. Soil blowing can be controlled by planting a cover crop between the tree rows.

If this soil is used as a site for septic tank absorption fields, fill material is needed to raise the absorption field a sufficient distance above the seasonal high water table. The soil readily absorbs but does not adequately filter the effluent in septic tank absorption fields. The poor filtering capacity can result in pollution of underground water supplies. The sides of shallow excavations can cave in unless they are shored. Shoring should be completed during dry periods. Constructing dwellings on raised, well compacted fill material helps to overcome the wetness. Constructing roads on suitable, well compacted fill material above the flood level, providing adequate roadside ditches, and installing culverts help to prevent the road damage caused by flooding and wetness. The damage to roads caused by frost action can be minimized by a good surface drainage system and by a gravel moisture barrier in the subgrade. Crowning the road by grading and constructing adequate roadside ditches help to provide the needed surface drainage.

The capability units are IVw-5, dryland, and IVw-11, irrigated; Subirrigated range site; windbreak suitability group 2S.

Bs—Bridget silt loam, 0 to 1 percent slopes. This very deep, nearly level, well drained soil is on stream terraces. It formed in silty, calcareous colluvial and alluvial sediments. Areas range from 5 to more than 100 acres in size

Typically, the surface layer is grayish brown, friable silt loam about 6 inches thick. The subsurface layer is dark grayish brown, friable silt loam about 6 inches thick. Next is a transitional layer of pale brown, friable silt loam about 8 inches thick. The underlying material to a depth of more than 60 inches is very pale brown silt loam. In some areas the dark surface layer is more than 20 inches thick.

Included with this soil in mapping are small areas of Bayard and Duroc soils. Bayard soils have more sand in the control section than the Bridget soil. They are in landscape positions slightly higher than those of the Bridget soil. Duroc soils have more clay in the control section than the Bridget soil. They have a mollic epipedon more than 20 inches thick. They are in landscape positions slightly lower than those of the Bridget soil. Included soils make up less than 10 percent of the map unit.

Permeability is moderate in the Bridget soil, and the available water capacity is high. Runoff is slow. The organic matter content is moderate. The water intake rate also is moderate.

Most of the acreage of this soil is used for irrigated crops. Corn and dry, edible beans are the principal crops in these areas. The remaining acreage is used as pasture.

If dry-farmed, this soil is suited to wheat, alfalfa, and grasses. The lack of precipitation is the major limitation. Soil blowing is a slight hazard in areas where the surface is not adequately protected by crops or crop residue. A system of conservation tillage, such as disking, chiseling, or summer fallowing, helps to control soil blowing and increases the moisture content in the subsoil. Returning crop residue to the soil improves the organic matter content and fertility.

If irrigated, this soil is suited to corn, beans, alfalfa, and grasses. Water can be applied by gravity or sprinkler irrigation systems. Efficient management of the irrigation water is needed. A system of conservation tillage, such as disking or chiseling, helps to control soil blowing. Returning crop residue to the soil and applying fertilizer can improve and maintain fertility.

This soil is suited to range. A cover of range plants is effective in controlling soil blowing. Overgrazing or improper haying methods reduce the amount of protective cover and the quality of native plants. Overgrazing also can result in the hazards of water erosion and soil blowing. Proper grazing use, timely deferment of grazing, and a planned grazing system help to keep the native plants in good condition.

This soil is suited to the trees and shrubs grown as windbreaks and to plantings that enhance recreational areas and wildlife habitat. The survival and growth rates of adapted species are good. Drought and weeds and grasses that compete with the trees for moisture are the main limitations. The weeds and undesirable grasses can be controlled by good site preparation, timely cultivation between the tree rows, or by applications of the appropriate herbicide. Irrigation can provide the moisture needed during dry periods.

The moderate permeability is a limitation on sites for septic tank absorption fields. It generally can be overcome by increasing the size of the field. This soil generally is suited to dwellings. The damage to roads caused by frost action can be minimized by a good surface drainage system. Crowning the road by grading and constructing adequate roadside ditches help to provide the needed surface drainage.

The capability units are IIc-1, dryland, and I-6, irrigated; Silty range site; windbreak suitability group 3.

BtB—Bridget loam, 1 to 3 percent slopes. This very deep, very gently sloping, well drained soil is on stream terraces. It formed in silty, calcareous colluvial and alluvial sediments. Areas range from 5 to more than 100 acres in size.

Typically, the surface layer is dark grayish brown, friable loam about 8 inches thick. The subsurface layer is grayish brown, friable loam about 8 inches thick. Next is a transitional layer of light brownish gray, friable loam about 12 inches thick. The underlying material to a depth of more than 60 inches is very pale brown loam. In some areas the dark surface layer is more than 20 inches thick.

Included with this soil in mapping are small areas of Bayard and Duroc soils. Bayard soils have more sand in the control section than the Bridget soil. They are in landscape positions slightly higher than those of the Bridget soil. Duroc soils have more clay in the control section than the Bridget soil. They have a mollic epipedon more than 20 inches thick. They are in landscape positions slightly lower than those of the Bridget soil. Included soils make up less than 10 percent of the map unit.

Permeability is moderate in the Bridget soil, and the available water capacity is high. Runoff is slow. The organic matter content is moderate. The water intake rate also is moderate.

Most of the acreage of this soil is used for irrigated crops. Corn and dry, edible beans are the principal crops in these areas. The remaining acreage is used as pasture.

If dry-farmed, this soil is suited to wheat, alfalfa, and grasses. The lack of precipitation is a limitation. Water erosion and soil blowing are slight hazards in areas where the surface is not adequately protected by crops, crop residue, or terraces. A system of conservation tillage, such as disking, chiseling, or summer fallowing, helps to control soil blowing and increases the moisture content in the subsoil. Returning crop residue to the soil improves the organic matter content and fertility. Channel terraces minimize the amount of water lost during periods of heavy rainfall and help to keep moisture on the fields for crops.

If irrigated, this soil is suited to corn, beans, alfalfa, and grasses. Water can be applied by gravity or sprinkler irrigation systems. Efficient management of the irrigation water is needed. A system of conservation tillage, such as disking or chiseling, helps to control soil blowing. Terraces minimize the amount of water lost during periods of heavy rainfall. Returning crop residue to the soil and applying fertilizer can improve and maintain fertility.

This soil is suited to range. A cover of range plants is effective in controlling soil blowing. Overgrazing or improper haying methods reduce the amount of protective cover and the quality of native plants. Overgrazing also can result in the hazards of water erosion and soil blowing. Proper grazing use, timely deferment of grazing, and a planned grazing system

help to keep the native plants in good condition.

This soil is suited to the trees and shrubs grown as windbreaks and to plantings that enhance recreational areas and wildlife habitat. The survival and growth rates of adapted species are good. Drought and weeds and grasses that compete with the trees for moisture are the main limitations. The weeds and undesirable grasses can be controlled by good site preparation, timely cultivation between the tree rows, or by applications of the appropriate herbicide. Irrigation can provide the moisture needed during dry periods.

The moderate permeability is a limitation on sites for septic tank absorption fields. It generally can be overcome by increasing the size of the field. This soil generally is suited to dwellings. The damage to roads caused by frost action can be minimized by a good surface drainage system. Crowning the road by grading and constructing adequate roadside ditches help to provide the needed surface drainage.

The capability units are IIe-1, dryland, and IIe-6, irrigated; Silty range site; windbreak suitability group 3.

ChB—Chappell fine sandy loam, 0 to 3 percent slopes. This very deep, nearly level and very gently sloping, well drained soil is on stream terraces. It formed in 20 to 40 inches of loamy material over gravelly coarse sand. Areas are elongated. They range from 5 to 100 acres in size.

Typically, the surface layer is dark grayish brown, friable fine sandy loam about 7 inches thick. The subsurface layer also is dark grayish brown, friable fine sandy loam. It is about 10 inches thick. The subsoil is light brown, friable fine sandy loam about 8 inches thick. The underlying material extends to a depth of more than 60 inches. It is pale brown fine sandy loam in the upper part and very pale brown gravelly coarse sand in the lower part. In a few areas, the dark upper layer is less than 10 inches thick and the depth to gravelly coarse sand is less than 20 inches.

Included with this soil in mapping are small areas of Bridget and Duroc soils. Bridget and Duroc soils do not have coarse material above a depth of 60 inches. They are slightly higher on the landscape than the Chappell soil. Bridget soils have less sand in the control section than the Chappell soil. Duroc soils have less sand and more clay in the control section than the Chappell soil. They have a mollic epipedon more than 20 inches thick. Included soils make up less than 10 percent of the map unit.

Permeability is moderately rapid in the upper part of the Chappell soil and very rapid in the lower part. The available water capacity is low. Runoff is slow. The organic matter content is moderately low. The water intake rate is moderately high.

Most of the acreage of this soil is used for irrigated crops. A few areas are used as pasture.

If dry-farmed, this soil is suited to wheat or grasses and to legumes for hay and pasture. Soil blowing is a hazard in areas where the surface is not adequately protected by crops or crop residue. A system of conservation tillage, such as disking or chiseling, that leaves crop residue on the surface helps to control soil blowing and conserve moisture. Summer fallowing can help to increase the moisture supply needed for winter wheat. Returning crop residue to the soil helps to improve and maintain the organic matter content, fertility, and tilth and increases the rate of water infiltration.

If irrigated, this soil is suited to corn, beans, grain sorghum, and alfalfa. Soil blowing and water erosion are hazards in areas where the surface is not adequately protected by crops or crop residue. A system of conservation tillage, such as disking or chiseling, that leaves crop residue on the surface helps to control soil blowing and water erosion. Because of the moderately high rate of water intake, this soil is best suited to sprinkler irrigation. Gravity irrigation systems are also suitable if areas are leveled or if a suitable grade is established so that excessive water erosion can be controlled.

This soil is suited to range and native hay. A cover of range plants is effective in controlling soil blowing. Overgrazing or improper haying methods reduce the amount of protective cover and the quality of native plants. As a result, soil blowing is excessive and small blowouts can form. Proper grazing use, timely deferment of grazing and haying, and a planned grazing system help to keep the native plants in good condition.

This soil is suited to the trees and shrubs grown as windbreaks and to plantings that enhance recreational areas and wildlife habitat. The survival and growth rates of adapted species are fair. Weeds and undesirable grasses that compete with the trees for moisture, a lack of seasonal rainfall, and soil blowing are hazards. Soil blowing can be controlled by maintaining strips of sod or cover crops between the tree rows. Irrigation can provide the moisture needed during dry periods. Hoeing by hand, rototilling, and applying the appropriate herbicide help to control plant competition in the tree rows. The low available water capacity is a limitation. The trees and shrubs selected for planting should be those that are tolerant of drought.

This soil readily absorbs but does not adequately filter the effluent in septic tank absorption fields. The poor filtering capacity can result in pollution of underground water supplies. The sides of shallow excavations can cave in unless they are shored. This soil generally is suited to dwellings and roads.

The capability units are IIIe-3, dryland, and IIIe-9, irrigated; Sandy range site; windbreak suitability group 6G.

Cu—Cullison fine sandy loam, 0 to 2 percent slopes. This very deep, nearly level, poorly drained soil is in swales in sandhill valleys. It formed in calcareous, loamy alluvium. It is subject to rare flooding. Areas range from 3 to 80 acres in size.

Typically, the surface layer is dark gray, friable, calcareous fine sandy loam about 7 inches thick. The subsurface layer is gray, friable, calcareous fine sandy loam about 11 inches thick. Next is a transitional layer of gray, friable, calcareous loam about 6 inches thick. The underlying material to a depth of 60 inches or more is gray and grayish brown, calcareous, mottled loam. In some areas the dark upper layer is more than 24 inches thick.

Included with this soil in mapping are small areas of Ipage and Marlake soils. Ipage soils are moderately well drained. They have more sand in the control section than the Cullison soil. They have a water table at a depth of 3 to 6 feet. They are in low, hummucky positions above the Cullison soil. Marlake soils are very poorly drained. They have a water table above the surface. They are in depressions below the Cullison soil. Included soils make up less than 10 percent of the map unit.

Permeability is moderate in the Cullison soil, and the available water capacity is high. Runoff is very slow. The organic matter content is high. The seasonal high water table is near the surface during wet years and at a depth of about 1.5 feet during dry years.

Most of the acreage of this soil supports native grasses and is used as hayland. Some small areas are used as pasture during dry periods. Because it is wet, this soil is not suited to cultivated crops.

If this soil is used as range or hayland, the climax vegetation is dominantly big bluestem, indiangrass, prairie cordgrass, switchgrass, sedges, and rushes. These species make up 60 percent or more of the total annual forage. Plains bluegrass, slender wheatgrass, northern reedgrass, and forbs make up the rest. If subject to continuous heavy grazing or improperly harvested for hay, big bluestem, indiangrass, switchgrass, and prairie cordgrass decrease in abundance and are replaced by slender wheatgrass and sedges. If overgrazing or improper haying methods continue for many years, plains bluegrass, sedges, rushes, and forbs dominate the site.

If the range is in excellent condition, the suggested initial stocking rate is 1.8 animal unit months per acre. A planned grazing system that includes proper grazing use, timely deferment of grazing and haying, and restricted use during very wet periods helps to maintain or improve the range condition. This soil is generally the first to be overgrazed when it is in a pasture that includes better drained, sandy soils. Properly located fences and livestock watering and salting facilities result in a more uniform distribution of grazing. Grazing and heavy machinery traffic when the soil is wet can result in surface compaction and the formation of small mounds and ruts, which make grazing and harvesting hay difficult.

If this soil is used as hayland, mowing should be regulated so that the grasses remain vigorous. The hay is of best quality when the grasses are cut early. After the ground is frozen, livestock can graze without damaging the meadows. They should be removed in spring, before the ground thaws and the water table reaches a high level.

This soil is suited to the trees and shrubs grown as windbreaks and to plantings that enhance recreational areas and wildlife habitat. Trees and shrubs that can withstand the occasional wetness survive and grow well. Cultivating and planting during wet years may be delayed until the soil has begun to dry.

This soil is not suited to septic tank absorption fields because of the wetness and a poor filtering capacity. A suitable alternative site should be selected. Constructing dwellings on raised, well compacted fill material helps to overcome the wetness caused by the high water table. Constructing roads on suitable, well compacted fill material, providing adequate roadside ditches, and installing culverts help to prevent the road damage caused by wetness. The damage to roads caused by frost action can be minimized by a good surface drainage system and by a gravel moisture barrier in the subgrade. Crowning the road by grading and constructing adequate roadside ditches help to provide the needed surface drainage.

The capability unit is Vw-7, dryland; Wet Subirrigated range site; windbreak suitability group 2D.

Cz—Cullison loam, wet, 0 to 2 percent slopes. This very deep, nearly level, very poorly drained soil is in swales in sandhill valleys. It formed in calcareous, loamy alluvium. It is subject to ponding. Areas range from 5 to 80 acres in size.

Typically, the surface layer is grayish brown, friable, calcareous loam about 3 inches thick. The subsurface layer is dark gray, friable, calcareous loam about 16 inches thick. The underlying material to a depth of 60 inches or more is light gray and gray, calcareous, mottled loam. In some areas the dark upper layer is more than 24 inches thick.

Included with this soil in mapping are small areas of the Ipage and Marlake soils. Ipage and Marlake soils

have more sand in the control section than the Cullison soil. Ipage soils are moderately well drained. They have a water table at a depth of 3 to 6 feet. They are in low hummucky positions above the Cullison soil. Marlake soils are very poorly drained. They have a water table above the surface. They are in depressions below the Cullison soil. Included soils make up less than 10 percent of the map unit.

Permeability is moderate in the Cullison soil, and the available water capacity is high. Runoff is very slow or ponded. The organic matter content is high. The seasonal high water table ranges from a depth of about 0.5 foot above the surface during wet years to about 1.0 foot during dry years.

Most of the acreage of this soil supports native grasses and is used as hayland. Some small areas are used as pasture during dry periods. Because it is wet, this soil is not suited to farming.

If this soil is used as range or hayland, the climax vegetation is dominantly prairie cordgrass, bluejoint reedgrass, northern reedgrass, and sedges. These species make up 65 percent or more of the total annual forage. Plains bluegrass, slender wheatgrass, and forbs make up the rest. If subject to continuous heavy grazing or improperly harvested for hay, prairie cordgrass, bluejoint reedgrass, and northern reedgrass decrease in abundance and are replaced by slender wheatgrass, bluegrass, sedges, rushes, and forbs. If overgrazing or improper haying methods continue for many years, bluegrass, foxtail barley, sedges, rushes, and forbs dominate the site.

If the range is in excellent condition, the suggested initial stocking rate is 2 animal unit months per acre. A planned grazing system that includes proper grazing use, timely deferment of grazing and haying, and restricted use during very wet periods helps to maintain or improve the range condition. Grazing and heavy machinery traffic when the soil is wet can result in surface compaction and the formation of mounds and ruts, which make grazing and harvesting hay difficult.

If this soil is used as hayland, mowing should be regulated so that the grasses remain vigorous. In wet years hay cannot be harvested in some areas of this soil. After the ground is frozen, livestock can graze without damaging the meadows. They should be removed in spring, before the ground thaws.

This soil generally is unsuited to the trees and shrubs grown as windbreaks. Some areas can support the trees or shrubs that enhance wildlife habitat if suitable species are planted by hand or if other special management is applied.

This soil is not suited to septic tank absorption fields because of the wetness or to dwellings because of the ponding. A suitable alternative site should be selected. Constructing roads on suitable, well compacted fill material above the level of ponding, providing adequate roadside ditches, and installing culverts help to prevent the road damage caused by ponding and wetness. The damage to roads caused by frost action can be minimized by a good surface drainage system and by a gravel moisture barrier in the subgrade. Crowning the road by grading and constructing adequate roadside ditches help to provide the needed surface drainage.

The capability unit is Vw-7, dryland; Wetland range site; windbreak suitability group 10.

DfE—Dix gravelly loam, 3 to 20 percent slopes. This very deep, gently sloping to moderately steep, excessively drained soil is on uplands. It formed in 4 to 10 inches of loamy and sandy material over very gravelly coarse sand. Areas range from 5 to 80 acres in size.

Typically, the surface layer is grayish brown, very friable gravelly loam about 4 inches thick. Next is a transitional layer of yellowish brown, loose gravelly loamy coarse sand about 6 inches thick. The underlying material to a depth of more than 60 inches is yellowish brown, loose very gravelly coarse sand. In some areas, the depth to the very gravelly material is less than 10 inches or the very gravelly material has been exposed at the surface. In other areas, the depth to gravelly material is more than 20 inches and the depth to dark colors is more than 10 inches.

Included with this soil in mapping are small areas of Sully and Tassel soils. Sully soils do not have coarse material above a depth of 60 inches. They are silty soils that formed in loess. They are on upper back slopes above the Dix soil. Tassel soils are shallow to calcareous sandstone bedrock. They are on lower back slopes below the Dix soil. Included soils make up less than 15 percent of the map unit.

Permeability is very rapid in the underlying material of the Dix soil. The available water capacity is very low. Runoff is medium. The organic matter content is moderately low.

All of the acreage of this soil is used as range. This soil is unsuited to dryland and irrigated crops because of the slope and droughtiness.

If this soil is used as range, the climax vegetation is dominantly hairy grama, blue grama, little bluestem, needleandthread, and sand bluestem. These species make up 55 percent or more of the total annual forage. Sand dropseed, sedges, and forbs make up the rest. If subject to continuous heavy grazing, sand bluestem, little bluestem, and prairie sandreed decrease in abundance and are replaced by blue grama, sand dropseed, needleandthread, sedges, and forbs. If overgrazing continues for many years, blue grama,

sedges, common pricklypear, brittle pricklypear, fringed sagebrush, and other forbs dominate the site.

If the range is in excellent condition, the suggested initial stocking rate is 0.4 animal unit month per acre. A planned grazing system that includes proper grazing use and timely deferment of grazing helps to maintain or improve the range condition. A planned, short period of heavy grazing during the grazing season or deferment of grazing in 2 out of 3 years helps to keep little bluestem and prairie sandreed in the plant community. Properly located fences and livestock watering and salting facilities can result in a more uniform distribution of grazing. The low available water capacity and droughtiness are limitations. The amount of forage produced depends on the frequency and amount of seasonal rainfall. Areas previously used as cropland should be reseeded to a suitable grass mixture if they are used as range.

This soil generally is unsuited to the trees and shrubs grown as windbreaks or plantings. Some small areas are suitable sites for planting trees; however, onsite investigation is needed.

This soil readily absorbs but does not adequately filter the effluent in septic tank absorption fields. The poor filtering capacity can result in pollution of underground water supplies. The sides of shallow excavations can cave in unless they are shored. Dwellings should be designed so that they conform to the natural slope of the land, or building sites should be graded to a suitable gradient. Cutting and filling can provide a suitable grade for roads.

The capability unit is VIs-4, dryland; Shallow to Gravel range site; windbreak suitability group 10.

DsG—Dix-Sully-Sarben complex, 20 to 60 percent slopes. These very deep, well drained and excessively drained, steep and very steep soils are on uplands. The excessively drained Dix soil formed in 4 to 10 inches of loamy and sandy material over very gravelly coarse sand. The well drained Sully soil formed in loess. The well drained Sarben soil formed in reworked loamy material. The Sully and Sarben soils do not have coarse material above a depth of 60 inches. The Dix soil is on narrow ridgetops and highly dissected side slopes. The Sully and Sarben soils are on broader convex side slopes and ridges. Areas range from 10 to several hundred acres in size. They are about 40 to 60 percent Dix soil, 20 to 40 percent Sully soil, and 20 to 40 percent Sarben soil. These two soils occur as areas so intricately mixed or so small in size that separating them in mapping is not practical.

Typically, the Dix soil has a surface layer of brown, very friable gravelly loam about 5 inches thick. The underlying material is yellowish brown, loose very gravelly coarse sand. In some areas the underlying material is calcareous.

Typically, the Sully soil has a surface layer of brown, friable silt loam about 4 inches thick. Next is a transitional layer of pale brown, friable, calcareous silt loam about 5 inches thick. The underlying material to a depth of more than 60 inches is pale brown, calcareous silt loam. In some areas the surface layer is calcareous. In places the underlying material is loamy very fine sand below a depth of 40 inches.

Typically, the Sarben soil has a surface layer of grayish brown, very friable loamy fine sand about 6 inches thick. Next is a transitional layer of brown loamy very fine sand about 9 inches thick. The underlying material extends to a depth of more than 60 inches. It is pale brown, loose loamy very fine sand in the upper part and very pale brown, calcareous, loamy very fine sand in the lower part. In some areas the dark color of the surface layer is more than 10 inches thick.

Included with these soils in mapping are small areas of Tassel and Otero soils. Tassel soils are shallow to calcareous sandstone bedrock. They are on lower backslopes. Otero soils do not have coarse material above a depth of 60 inches. They are loamy soils that formed in colluvium. They are generally on foot slopes. Included soils make up less than 15 percent of the map unit.

Permeability is very rapid in the Dix soil, moderate in the Sully soil, and moderately rapid in the Sarben soil. The available water capacity is very low in the Dix soil and high in the Sully and Sarben soils. Runoff is rapid on all three soils. The organic matter content is moderately low in the Dix soil and low in the Sully and Sarben soils.

Most of the acreage of these soils supports native grasses and is used as range. These soils are not suited to cultivated crops because of droughtiness and the slope.

If these soils are used as range, the climax vegetation is dominantly hairy grama, blue grama, little bluestem, needleandthread, prairie sandreed, and sand bluestem. These species make up 55 percent or more of the total annual forage. Sand dropseed, western wheatgrass, sedges, and forbs make up the rest. If subject to continuous heavy grazing, sand bluestem, little bluestem, and prairie sandreed decrease in abundance and are replaced by blue grama, sand dropseed, needleandthread, sedges, and forbs. If overgrazing continues for many years, blue grama, sedges, common pricklypear, brittle pricklypear, fringed sagewort, sand sagebrush, and other forbs dominate the site.

If the range is in excellent condition, the suggested initial stocking rate is 0.4 animal unit month per acre on

the Dix and Sully soil and 0.7 animal unit month per acre on the Sarben soil. A planned grazing system that includes proper grazing use and timely deferment of grazing helps to maintain or improve the range condition. A planned, short period of heavy grazing during the grazing season or deferment of grazing in 2 out of 3 years helps to keep little bluestem and prairie sandreed in the plant community. Properly located fences and livestock watering and salting facilities can result in a more uniform distribution of grazing. The low available water capacity and droughtiness are limitations. The amount of forage produced depends on the frequency and amount of seasonal rainfall. Areas previously used as cropland should be reseeded to a suitable grass mixture if they are used as range.

These soils generally are unsuited to the trees and shrubs grown as windbreaks and plantings. The slope prevents the use of conventional tree-planting and tillage equipment. Some small areas are suitable sites for planting trees; however, onsite investigation is needed.

These soils generally are not suited to sanitary facilities because of the slope. A suitable alternative site should be selected. The Dix soil readily absorbs but does not adequately filter the effluent in septic tank absorption fields. The poor filtering capacity can result in pollution of underground water supplies. The sides of shallow excavations in the Dix soil can cave in unless they are shored. Dwellings should be designed so that they conform to the natural slope of the land, or building sites should be graded to a suitable gradient. Cutting and filling can provide a suitable grade for roads.

The capability unit is VIIs-4, dryland; windbreak suitability group 10. The Dix soil is in the Shallow to Gravel range site, the Sully soil is in the Thin Loess range site, and the Sarben soil is in the Sandy range site.

Dt—Duroc loam, terrace, 0 to 1 percent slopes. This very deep, nearly level, well drained soil is on stream terraces of the North Platte and South Platte Rivers. It formed in silty alluvium over sand and coarse sand. Areas are irregular in shape and range from 5 to more than 200 acres in size.

Typically, the surface layer is grayish brown, friable loam about 7 inches thick. The subsoil is about 29 inches thick. The upper part is grayish brown, friable loam, the next part is dark grayish brown, friable loam, and the lower part is brown, friable silt loam. The underlying material to a depth of 60 inches is light gray, calcareous silt loam. Strata of sand and coarse sand are at a depth of 60 inches or more. In some areas the subsoil contains more clay.

Included with this soil in mapping are small areas of Bayard and Bridget soils. Bayard and Bridget soils have a mollic epipedon less than 20 inches thick. They are in landscape positions slightly higher than those of the Duroc soil. Bayard soils have more sand and less clay in the control section than the Duroc soil. Bridget soils have less clay in the control section than the Duroc soil. Included soils make up 5 to 15 percent of the map unit.

Permeability is moderate in the Duroc soil, and the available water capacity is high. Runoff is slow. The organic matter content is moderate. The water intake rate also is moderate.

Most of the acreage of this soil is used for irrigated crops. A few areas are used as pasture.

If dry-farmed, this soil is suited to wheat, corn, alfalfa, and grasses. The lack of precipitation is the major limitation. Soil blowing is a slight hazard in areas where the surface is not adequately protected by crops or crop residue. A system of conservation tillage, such as summer fallowing, disking, or chiseling, helps to increase the moisture supply in the subsoil and to control soil blowing.

If irrigated, this soil is suited to corn, beans, alfalfa, and grasses. Water can be applied by gravity and sprinkler irrigation systems. Efficient management of the irrigation water is needed. Soil blowing is a slight hazard. A system of conservation tillage, such as disking or chiseling, helps to control soil blowing. Returning crop residue to the soil and applying barnyard manure help to improve and maintain organic matter content, fertility, and tilth and increase the rate of water infiltration.

This soil is suited to range. A cover of range plants is effective in controlling soil blowing. Overgrazing or improper haying methods reduce the amount of protective cover and the quality of native plants. Overgrazing also can result in the hazards of water erosion and soil blowing. Proper grazing use, timely deferment of grazing, and a planned grazing system help to keep the native plants in good condition.

This soil is suited to the trees and shrubs grown as windbreaks and to plantings that enhance recreational areas and wildlife habitat. The survival and growth rates of adapted species are good. Drought and weeds and grasses that compete with the trees for moisture are the main limitations. The weeds and undesirable grasses can be controlled by good site preparation, timely cultivation between the tree rows, or by applications of the appropriate herbicide. Irrigation can provide the moisture needed during dry periods.

The moderate permeability is a limitation on sites for septic tank absorption fields. It generally can be overcome by increasing the size of the field. The foundation of buildings should be strengthened and backfilled with coarse material to prevent the damage

caused by caused by shrinking and swelling. Roads built on this soil need to be designed so that the surface pavement and base material are thick enough to compensate for the low strength of the soil. Coarser grained base material can be used to ensure better performance.

The capability units are IIc-1, dryland, and I-6, irrigated; Silty range site; windbreak suitability group 3.

DtB—Duroc loam, terrace, 1 to 3 percent slopes. This very deep, very gently sloping, well drained soil is on stream terraces of the North Platte and South Platte Rivers. It formed in silty alluvium over sand and coarse sand. Areas are irregular in shape and range from 5 to more than 200 acres in size.

Typically, the surface layer is grayish brown, friable loam about 6 inches thick. The subsoil is about 26 inches thick. The upper part is grayish brown, friable loam, the next part is dark grayish brown, friable loam, and the lower part is grayish brown loam. The underlying material to a depth of more than 60 inches is very pale brown, calcareous loam. In some areas the surface layer is lighter in color. In other areas the underlying material contains more sand.

Included with this soil in mapping are small areas of Bayard and Bridget soils. Bayard and Bridget soils have a mollic epipedon less than 20 inches thick. They are in landscape positions slightly higher than those of the Duroc soil. Bayard soils have more sand and less clay in the control section than the Duroc soil. Bridget soils have less clay in the control section than the Duroc soil. Included soils make up 5 to 15 percent of the map unit.

Permeability is moderate in the Duroc soil, and the available water capacity is high. Runoff is slow. The organic matter content is moderate. The water intake rate also is moderate.

Most of the acreage of this soil is used for irrigated crops. A few areas are used as pasture.

If dry-farmed, this soil is suited to wheat, corn, alfalfa, and grasses. The lack of precipitation is a limitation. Water erosion and soil blowing are hazards in areas where the surface is not adequately protected by crops, crop residue, or terraces. A system of conservation tillage, such as summer fallowing, disking, or chiseling, helps to increase the moisture supply in the subsoil and to control soil blowing. Channel terraces minimize the amount of water lost during periods of heavy rainfall and help to keep moisture on the fields for crops.

If irrigated, this soil is suited to corn, beans, alfalfa, and grasses. Water can be applied by gravity and sprinkler irrigation systems. Efficient management of the irrigation water is needed. Water erosion and soil blowing are hazards. A system of conservation tillage, such as disking or chiseling, helps to control soil blowing. Terraces minimize the amount of water lost during periods of heavy rainfall. Returning crop residue to the soil and applying barnyard manure help to improve and maintain organic matter content, fertility, and tilth and increase the rate of water infiltration.

This soil is suited to range. A cover of range plants is effective in controlling soil blowing. Overgrazing or improper haying methods reduce the amount of protective cover and the quality of native plants. Overgrazing also can result in the hazards of water erosion and soil blowing. Proper grazing use, timely deferment of grazing, and a planned grazing system help to keep the native plants in good condition.

This soil is suited to the trees and shrubs grown as windbreaks and to plantings that enhance recreational areas and wildlife habitat. The survival and growth rates of adapted species are good. Drought and weeds and grasses that compete with the trees for moisture are the main limitations. The weeds and undesirable grasses can be controlled by good site preparation, timely cultivation between the tree rows, or by applications of the appropriate herbicide. Irrigation can provide the moisture needed during dry periods.

The moderate permeability is a limitation on sites for septic tank absorption fields. It generally can be overcome by increasing the size of the field. The foundation of buildings should be strengthened and backfilled with coarse material to prevent the damage caused by shrinking and swelling. Roads built on this soil need to be designed so that the surface pavement and base material are thick enough to compensate for the low strength of the soil. Coarser grained base material can be used to ensure better performance.

The capability units are IIe-1, dryland, and IIe-6, irrigated; Silty range site; windbreak suitability group 3.

Du—Duroc silt loam, 0 to 1 percent slopes. This very deep, nearly level, well drained soil is in swales on uplands. It formed in silty local colluvium and alluvium. Areas are irregular in shape and range from 5 to more than 100 acres in size.

Typically, the surface layer is grayish brown, friable silt loam about 6 inches thick. The subsurface layer also is grayish brown, friable silt loam. It is about 19 inches thick. The subsoil is brown, calcareous silt loam about 25 inches thick. The underlying material to a depth of more than 60 inches is pale brown, calcareous silt loam. In some areas the surface layer is lighter in color.

Included with this soil in mapping are small areas of Keith, Lodgepole, and Satanta soils. Keith and Satanta soils have a mollic epipedon less than 20 inches thick. Keith soils are in landscape positions higher than those

of the Duroc soil. Satanta soils have more sand in the control section than the Duroc soil. Also, they are slightly higher on the landscape. Lodgepole soils have more clay in the subsoil than the Duroc soil. They are in somewhat poorly drained depressions. Included soils make up 5 to 15 percent of the map unit.

Permeability is moderate in the Duroc soil, and the available water capacity is high. Runoff is slow. The organic matter content is moderate. The water intake rate also is moderate.

Most of the acreage of this soil is used for cultivated crops. A few areas are used as pasture.

If dry-farmed, this soil is suited to wheat, corn, alfalfa, and grasses. The lack of precipitation is the major limitation. Soil blowing is a slight hazard in areas where the surface is not adequately protected by crops or crop residue. A system of conservation tillage, such as summer fallowing, disking, or chiseling, helps to increase the moisture supply in the subsoil and to control soil blowing.

If irrigated, this soil is suited to corn, beans, alfalfa, and grasses. Water can be applied by gravity and sprinkler irrigation systems. Efficient management of the irrigation water is needed. Soil blowing is a slight hazard. A system of conservation tillage, such as disking or chiseling, helps to control soil blowing. Returning crop residue to the soil and applying barnyard manure help to improve and maintain organic matter content, fertility, and tilth and increase the rate of water infiltration.

This soil is suited to range. A cover of range plants is effective in controlling soil blowing. Overgrazing or improper haying methods reduce the amount of protective cover and the quality of native plants. Overgrazing also can result in the hazards of water erosion and soil blowing. Proper grazing use, timely deferment of grazing, and a planned grazing system help to keep the native plants in good condition.

This soil is suited to the trees and shrubs grown as windbreaks and to plantings that enhance recreational areas and wildlife habitat. The survival and growth rates of adapted species are good. Drought and weeds and grasses that compete with the trees for moisture are the main limitations. The weeds and undesirable grasses can be controlled by good site preparation, timely cultivation between the tree rows, or by applications of the appropriate herbicide. Irrigation can provide the moisture needed during dry periods.

The moderate permeability is a limitation on sites for septic tank absorption fields. It generally can be overcome by increasing the size of the field. The foundation of buildings should be strengthened and backfilled with coarse material to prevent the damage caused by shrinking and swelling. Roads built on this soil need to be designed so that the surface pavement and base material are thick enough to compensate for the low strength of the soil. Coarser grained base material can be used to ensure better performance.

The capability units are IIc-1, dryland, and I-6, irrigated; Silty range site; windbreak suitability group 3.

DuB—Duroc silt loam, 1 to 3 percent slopes. This very deep, very gently sloping, well drained soil is in swales on uplands. It formed in silty local colluvium and alluvium. Areas are irregular in shape and range from 5 to more than 100 acres in size.

Typically, the surface layer is grayish brown, friable silt loam about 6 inches thick. The subsoil is about 44 inches thick. The upper part is grayish brown, friable silt loam, the next part is grayish brown, friable silt loam, and the lower part is brown, calcareous silt loam. The underlying material to a depth of more than 60 inches is pale brown, calcareous silt loam. In some areas the surface layer is lighter in color. In other areas the subsoil contains more clay.

Included with this soil in mapping are small areas of Keith, Lodgepole, and Satanta soils. Keith and Satanta soils have a mollic epipedon less than 20 inches thick. Keith soils are in landscape positions higher than those of the Duroc soil. Satanta soils have more sand in the control section than the Duroc soil. Also, they are slightly higher on the landscape. Lodgepole soils have more clay in the subsoil than the Duroc soil. They are in somewhat poorly drained depressions. Included soils make up 5 to 15 percent of the map unit.

Permeability is moderate in the Duroc soil, and the available water capacity is high. Runoff is slow. The organic matter content is moderate. The water intake rate also is moderate.

Most of the acreage of this soil is used for cultivated crops. A few areas are used as pasture.

If dry-farmed, this soil is suited to wheat, corn, alfalfa, and grasses. The lack of precipitation is a limitation. Water erosion and soil blowing are hazards in areas where the surface is not adequately protected by crops, crop residue, or terraces. A system of conservation tillage, such as summer fallowing, disking, or chiseling, helps to increase the moisture supply in the subsoil and to control soil blowing. Channel terraces minimize the amount of water lost during periods of heavy rainfall and help to keep moisture on the fields for crops.

If irrigated, this soil is suited to corn, beans, alfalfa, and grasses (fig. 10). Water can be applied by gravity and sprinkler irrigation systems. Efficient management of the irrigation water is needed. Water erosion and soil blowing are hazards. A system of conservation tillage, such as disking or chiseling, helps to control of soil

Figure 10.—Irrigated corn in an area of Duroc silt loam, 1 to 3 percent slopes.

blowing. Terraces minimize the amount of water lost during periods of heavy rainfall. Returning crop residue to the soil and applying barnyard manure help to improve and maintain organic matter content, fertility, and tilth and increase the rate of water infiltration.

This soil is suited to range. A cover of range plants is effective in controlling soil blowing. Overgrazing or improper haying methods reduce the amount of protective cover and the quality of native plants. Overgrazing also can result in the hazards of water erosion and soil blowing. Proper grazing use, timely deferment of grazing, and a planned grazing system help to keep the native plants in good condition.

This soil is suited to the trees and shrubs grown as windbreaks and to plantings that enhance recreational areas and wildlife habitat. The survival and growth rates of adapted species are good. Drought and weeds and grasses that compete with the trees for moisture are the main limitations. The weeds and undesirable grasses can be controlled by good site preparation, timely cultivation between the tree rows, or by applications of the appropriate herbicide. Irrigation can provide the moisture needed during dry periods.

The moderate permeability is a limitation on sites for septic tank absorption fields. It generally can be overcome by increasing the size of the field. The foundation of buildings should be strengthened and backfilled with coarse material to prevent the damage caused by shrinking and swelling. Roads built on this soil need to be designed so that the surface pavement and base material are thick enough to compensate for the low strength of the soil. Coarser grained base

material can be used to ensure better performance.

The capability units are IIe-1, dryland, and IIe-6, irrigated; Silty range site; windbreak suitability group 3.

Fu—Fluvaquents, sandy. These very deep, nearly level, very poorly drained soils are on bottom land that is mainly along the North Platte River upstream from Lake McConaughy. They formed in alluvium. They are frequently flooded. They range from 5 to 80 acres in size.

Typically, the surface layer is black and very dark gray partially decomposed organic material about 10 inches thick. The underlying material extends to a depth of 60 inches. It is very dark gray sand in the upper part and dark gray to gray stratified coarse sand and gravelly coarse sand in the lower part. The thickness of the partially decomposed organic material ranges from 2 to 20 inches.

Included with these soils in mapping are small areas of Gothenburg and Platte soils. The Gothenburg and Platte soils have a seasonal high water table that is farther from the surface than that in the Fluvaquents. Also, they are slightly higher on the landscape. Included soils make up less than 10 percent of the map unit.

Permeability is rapid. The available water capacity is low. The organic matter content is high. Because of a seasonal water table that ranges from a depth of about 2 feet above the surface to about 1 foot below the surface, the soil is saturated during most of the year. Ponding may occur for long periods during most years. During dry periods the water table may drop below the surface.

All of the acreage of these soils supports native vegetation, which consists dominantly of sedges, reeds, cattails, arrowheads, and indigobush.

These soils are unsuited to cultivated crops, windbreaks, pasture, and range because of the high water table and the flooding. They are suited to the plants that provide food and cover for wildlife.

These soils are unsuited to building site development, sanitary facilities, and roads because of the wetness and the flooding. Roads should be constructed on suitable, well compacted fill material above the seasonal high water table and the flood level. Providing adequate roadside ditches and installing culverts or bridges help to prevent the road damage caused by flooding.

The capability unit is VIIIw-7, dryland; windbreak suitability group 10. No range site is assigned.

Go—Gothenburg loamy sand, 0 to 2 percent slopes. This very deep, nearly level, poorly drained soil is on bottom land. It formed in 1 to 10 inches of sandy alluvium over gravelly coarse sand. It is occasionally flooded. Areas are commonly long and parallel to the rivers. They range from 5 to several hundred acres in size.

Typically, the surface layer is grayish brown, very friable loamy sand about 3 inches thick. The underlying material extends to a depth of more than 60 inches. It is grayish brown, very friable sand in the upper part and light brownish gray gravelly coarse sand in the lower part. In some areas sand, coarse sand, or gravelly sand is at the surface.

Included with this soil in mapping are small areas of Alda and Platte soils. Alda and Platte soils are in landscape positions slightly higher than those of the Gothenburg soil. They have a mollic epipedon. Alda soils have more silt and clay in the control section than the Gothenburg soil. They have coarse sand at a depth of 20 to 40 inches. Platte soils have gravelly coarse sand at a depth of 10 to 20 inches.

Permeability is rapid in the surface layer of the Gothenburg soil and rapid and very rapid in the underlying material. The available water capacity is very low. Runoff is slow. The organic matter content is very low. The seasonal high water table is near the surface during wet years and at a depth of about 2 feet during dry years.

All of the acreage of this soil supports grasses, weeds, shrubs, and sedges interspersed with cottonwood, cedar, and willow trees. This soil is poorly suited to plants that provide food and cover for wildlife.

The suitability of this soil for grazing is limited because of the shallow rooting depth. Overgrazing reduces the protective cover and causes deterioration of the native plants.

This soil is not suited to windbreaks, sanitary facilities, or building site development because of the flooding and wetness. A suitable alternative site should be selected. The flooding commonly damages fences. In places sand and gravel can be excavated and used for construction. Constructing roads on suitable, well compacted fill material, providing adequate roadside ditches, and installing culverts help protect roads from flood damage and wetness. Ponds can be created by excavating enough soil so that the water table is reached. They can be used for livestock watering and for fish and wildlife habitat.

The capability unit is VIIs-3, dryland; windbreak suitability group 10. No range site is assigned.

IpB—Ipage fine sand, 0 to 3 percent slopes. This very deep, nearly level and very gently sloping, moderately well drained soil is on low hummocks and in concave areas in sandhill valleys and on stream terraces. It formed in sandy eolian and colluvial material. Areas are irregular in shape and range from 5

to more than 200 acres in size.

Typically, the surface layer is grayish brown, very friable fine sand about 9 inches thick. Next is a transitional layer of brown, very friable fine sand about 5 inches thick. The underlying material to a depth of more than 60 inches is pale brown, loose fine sand. Few, fine, distinct yellowish brown mottles are below a depth of 30 inches. In some places the dark color of the surface layer is at a depth of more than 10 inches. In other places the underlying material is loamy.

Included with this soil in mapping are small areas of Cullison and Valent soils. Cullison soils are poorly drained and very poorly drained. They have less sand in the control section than the Ipage soil. They are in depressions. Valent soils are excessively drained. They are in landscape positions that are higher than those of the Ipage soil. Included soils make up less than 15 percent of the map unit.

Permeability is rapid in the Ipage soil, and the available water capacity is low. Runoff is slow. The organic matter content is low. The water intake rate is very high. The seasonal high water table ranges from a depth of about 3 feet during wet years to about 6 feet during dry years.

Most of the acreage of this soil is used as range. Some small areas are irrigated with center-pivot irrigation systems. Corn and alfalfa are the principal crops in these areas.

If irrigated by sprinklers, this soil is poorly suited to corn and alfalfa. Soil blowing is a hazard in areas where the surface is not adequately protected by crops or crop residue. A system of conservation tillage, such as chiseling, that leaves crop residue on the surface helps to control soil blowing. Efficiently managing irrigation water can prevent overirrigation and the loss of plant nutrients. Fertilizer will be more readily available to plants if applications of the fertilizer are made with a sprinkler irrigation system.

If this soil is used as range or hayland, the climax vegetation is dominantly sand bluestem, little bluestem, prairie sandreed, needleandthread, and switchgrass. These species make up 55 percent or more of the total annual forage. Blue grama, indiangrass, sedges, and forbs make up the rest. If subject to continuous heavy grazing or improperly harvested for hay, sand bluestem, little bluestem, indiangrass, and switchgrass decrease in abundance and are replaced by prairie sandreed, needleandthread, sand dropseed, blue grama, sedges, and forbs. If overgrazing or improper haying methods continue for many years, blue grama, sand dropseed, needleandthread, Scribner panicum, sedges, and forbs dominate the site.

If the range is in excellent condition, the suggested initial stocking rate is 0.9 animal unit month per acre. A planned grazing system that includes proper grazing use and timely deferment of grazing and haying helps to maintain or improve the range condition. Properly located fences and livestock watering and salting facilities result in a more uniform distribution of grazing. Areas previously used as cropland should be reseeded to a suitable grass mixture if they are used as range.

If this soil is used as hayland, mowing should be regulated so that the grasses remain vigorous. The forage should be harvested only every other year. During the year the forage is not harvested, the hayland should be used only as fall or winter range.

This soil is suited to the trees and shrubs grown as windbreaks and to plantings that enhance recreational areas and wildlife habitat. The survival and growth rates of adapted species are fair. Soil blowing, the loose soil on the surface, and the lack of seasonal rainfall are hazards. Young seedlings can be damaged by windblown sand. Soil blowing can be controlled by maintaining strips of sod or cover crops between the tree rows. The trees need to be planted in shallow furrows with as little disturbance of the soil as possible. Irrigation can provide the moisture needed for establishing seedlings during dry periods. Hoeing by hand or rototilling help to control plant competition in the tree rows.

If this soil is used as a site for septic tank absorption fields, fill material is needed to raise the absorption field a sufficient distance above the seasonal high water table. The soil readily absorbs but does not adequately filter the effluent in septic tank absorption fields. The poor filtering capacity can result in pollution of underground water supplies. The sides of shallow excavations can cave in unless they are shored. Shoring should be completed during dry periods. Constructing dwellings on raised, well compacted fill material helps to overcome the wetness. The damage to roads caused by frost action can be minimized by a good surface drainage system and by a gravel moisture barrier in the subgrade. Crowning the road by grading and constructing adequate roadside ditches help to provide the needed surface drainage.

The capability units are VIe-5, dryland, and IVe-12, irrigated; Sandy Lowland range site; windbreak suitability group 7.

Ja—Janise loam, 0 to 2 percent slopes. This very deep, somewhat poorly drained, nearly level, alkali soil is on bottom land. It formed in calcareous, loamy alluvium. It is occasionally flooded. Areas range from 5 to 300 acres in size.

Typically, the surface layer is gray, very friable, calcareous loam about 3 inches thick. The subsurface layer is grayish brown, very friable, calcareous loam

about 5 inches thick. Next is a transitional layer of light brownish gray, calcareous loam about 6 inches thick. The underlying material extends to a depth of 60 inches or more. It is light gray and white, calcareous loam in the upper part, light gray and light brownish gray, calcareous very fine sandy loam and loamy very fine sand in the next part, and pale brown, calcareous coarse sand in the lower part. The soil is moderately alkaline or strongly alkaline at a depth of 0 to 8 inches. In most areas the soil is very strongly alkaline below a depth of 8 inches. In some areas the dark surface layer is as much as 20 inches thick.

Included with this soil in mapping are small areas of Janise, drained, and Lawet soils. Janise, drained, soils have a water table at a depth of more than 6 feet. They are in landscape positions slightly higher than those of the Janise soil. Lawet soils are not so calcareous as the Janise soil. Also, they are slightly lower on the landscape. Included soils make up about 10 to 20 percent of the map unit.

Permeability is moderately slow in the Janise soil, and the available water capacity is moderate. Runoff is slow. The organic matter content is low. The seasonal high water table ranges from a depth of about 2 feet during wet years to about 3 feet during dry years. This soil has excessive amounts of sodium, which results in a poor infiltration rate, poor aeration, and surface crusting.

Nearly all of the acreage of this soil supports native grasses and is used as hayland or pasture.

This soil is not suited to cultivated crops because of the high salinity and alkalinity and the shallow rooting depth.

If this soil is used as range or hayland, the climax vegetation is dominantly alkali sacaton, inland saltgrass, western wheatgrass, slender wheatgrass, and plains bluegrass. These species make up 65 percent or more of the total annual forage. Sedges and forbs make up the rest. If subject to continuous heavy grazing or improperly harvested for hay, alkali sacaton and western wheatgrass decrease in abundance and are replaced by inland saltgrass, plains bluegrass, and alkali-tolerant sedges. If overgrazing or improper haying methods continue for many years, inland saltgrass, plains bluegrass, alkali-tolerant sedges, rushes, and forbs dominate the site.

If the range is in excellent condition, the suggested initial stocking rate is 0.9 animal unit month per acre. A planned grazing system that includes proper grazing use, timely deferment of grazing and haying, and restricted use during wet periods helps to maintain or improve the range condition. Properly located fences and livestock watering and salting facilities result in a more uniform distribution of grazing. The alkalinity limits forage production and greatly influences the kinds of plants that grow. Some very strongly alkaline areas support little or no vegetation and are subject to severe soil blowing during dry periods. Careful management is needed to maintain the plant cover.

If this soil is used as hayland, mowing should be regulated so that the grasses remain vigorous. After the ground is frozen, livestock can graze without damaging the meadows. They should be removed in spring, before the ground thaws.

This soil generally is unsuited to the trees and shrubs grown as windbreaks. Some areas can support the trees and shrubs that enhance wildlife habitat if suitable species are planted by hand or if other special management is applied.

This soil is not suited to septic tank absorption fields and dwellings because of the flooding. A suitable alternative site should be selected. Constructing roads on suitable, well compacted fill material above the flood level, providing adequate roadside ditches, and installing culverts help to prevent the road damage caused by flooding and wetness. The damage to roads caused by frost action can be minimized by a good surface drainage system and by a gravel moisture barrier in the subgrade. Crowning the road by grading and constructing adequate roadside ditches help to provide the needed surface drainage.

The capability unit is VIs-1, dryland; Saline Subirrigated range site; windbreak suitability group 10.

Jd—Janise loam, drained, 0 to 2 percent slopes. This very deep, moderately well drained, nearly level, alkali soil is on high bottom land. It formed in calcareous, loamy alluvium. It is subject to rare flooding. Areas range from 5 to 200 acres in size.

Typically, the surface layer is grayish brown, calcareous loam about 7 inches thick. The subsoil is about 17 inches thick. It is grayish brown, calcareous silty clay loam in the upper part, light brownish gray, calcareous silty clay loam in the next part, and light gray, calcareous loam in the lower part. The underlying material extends to a depth of more than 60 inches. It is white, calcareous loam in the upper part and pale olive, calcareous loam in the lower part. Typically, this soil is strongly alkaline or very strongly alkaline at a depth of 7 to 60 inches. In some places the dark surface layer is as much as 12 inches thick. In other places the subsoil is clay loam.

Included with this soil in mapping are small areas of the somewhat poorly drained Boel and Janise soils. Boel soils have more sand in the control section than the Janise soil. Also, they are not so calcareous. They are in landscape positions higher than those of the Janise soil. The somewhat poorly drained Janise soils

are in landscape positions slightly lower than those of the Janise, drained, soil. Included soils make up about 10 to 20 percent of the map unit.

Permeability is moderately slow in the Janise soil, and the available water capacity is high. Runoff is slow. The organic matter content is low. The water intake rate is moderate. This soil has excessive amounts of sodium, which results in a poor infiltration rate, poor aeration, and surface crusting.

Most of the acreage of this soil supports native grasses and is used as hayland or pasture. Some small areas are irrigated with center-pivot irrigation systems. Corn and alfalfa are the principal crops grown in these areas.

This soil is not suited to dryland farming because it is very strongly saline and alkaline.

If irrigated, this soil is poorly suited to corn, alfalfa, and introduced grasses. The high alkalinity is the main limitation. Soil blowing is a slight hazard. Applying feedlot manure and soil amendments, such as gypsum or sulfur, helps to reduce the alkalinity. A system of conservation tillage, such as ecofallow or no-till plant, that leaves crop residue on the surface helps to control soil blowing, conserve moisture, and increase the water intake rate. Chiseling helps to increase the rate of water infiltration. Cover crops help to control soil blowing. This soil is suited to both sprinkler and gravity irrigation systems. Some land leveling generally is needed when a gravity irrigation system is installed to provide a suitable grade for uniform distribution of water and improved surface drainage.

If this soil is used as range or hayland, the climax vegetation is dominantly alkali sacaton, inland saltgrass, blue grama, and western wheatgrass. These species make up 65 percent or more of the total annual forage. Buffalograss, sand dropseed, slender wheatgrass, sedges, and forbs make up the rest. If subject to continuous heavy grazing or improperly harvested for hay, alkali sacaton, western wheatgrass, and slender wheatgrass decrease in abundance and are replaced by inland saltgrass, blue grama, buffalograss, sand dropseed, and sedges.

If the range is in excellent condition, the suggested initial stocking rate is 0.7 animal unit month per acre. A planned grazing system that includes proper grazing use and timely deferment of grazing and haying helps to maintain or improve the range condition. Properly located fences and livestock watering and salting facilities result in a more uniform distribution of grazing. The alkalinity of the soil varies, which results in irregular patterns of short and tall grasses. Short grasses are dominant in areas where the alkalinity is high.

If this soil is used as hayland, the forage should be harvested only every other year. During the year the forage is not harvested, the hayland should be used only as fall or winter range. Mowing should be regulated so that the grasses remain vigorous.

This soil generally is unsuited to the trees and shrubs grown as windbreaks. Some areas can support the trees or shrubs that enhance wildlife habitat if suitable species are planted by hand or if other special management is applied.

The flooding and the moderately slow permeability are limitations on sites for septic tank absorption fields. The restricted permeability generally can be overcome by increasing the size of the fields. Constructing dwellings on raised, well compacted fill material helps to prevent the damage caused by flooding. Constructing roads on suitable, well compacted fill material above the flood level, providing adequate roadside ditches, and installing culverts help to prevent the road damage caused by flooding. The damage to roads caused by frost action can be minimized by a good surface drainage system and by a gravel moisture barrier in the subgrade. Crowning the road by grading and constructing adequate roadside ditches help to provide the needed surface drainage.

The capability units are VIs-1, dryland, and IVs-6, irrigated; Saline Lowland range site; windbreak suitability group 10.

KeB—Keith loam, 1 to 3 percent slopes. This very deep, very gently sloping, well drained soil is on uplands. It formed in loess. Areas are irregular in shape and range from 5 to more than 300 acres in size.

Typically, the surface layer is dark grayish brown, very friable loam about 6 inches thick. The subsurface layer also is dark grayish brown, very friable loam. It is about 5 inches thick. The subsoil is about 21 inches thick. The upper part is grayish brown and brown, friable silt loam and the lower part is very pale brown, very friable silt loam. The underlying material to a depth of more than 60 inches is very pale brown silt loam. In a few areas the surface soil is lighter in color.

Included with this soil in mapping are small areas of Duroc and Lodgepole soils. Duroc soils have a mollic epipedon more than 20 inches thick. They are in landscape positions slightly lower than those of the Keith soil. Lodgepole soils have more clay in the subsoil than the Keith soil. They are in somewhat poorly drained potholes. Included soils make up less than 10 percent of the map unit.

Permeability is moderate in the Keith soil, and the available water capacity is high. Runoff is slow or medium. The organic matter content is moderate. The water intake rate is moderately low.

Most of the acreage of this soil is used for cultivated crops. Some areas are irrigated if water is available. A

few areas are used as range.

If dry-farmed, this soil is suited to winter wheat and corn and to grasses and legumes for hay and pasture. Water erosion and soil blowing are hazards in areas where the surface is not adequately protected by crops or crop residue. A system of conservation tillage, such as disking or chiseling, that leaves crop residue on the surface helps to control soil blowing and water erosion and conserve moisture. Channel terraces minimize the amount of water lost during periods of heavy rainfall and help to keep moisture on the fields for crops. Summer fallowing can help to increase the moisture supply needed for winter wheat. Returning crop residue to the soil helps to improve and maintain organic matter content, fertility, and tilth and increases the rate of water infiltration.

If irrigated, this soil is suited to corn, beans, alfalfa, and grasses. Soil blowing and water erosion are the principal hazards. A system of conservation tillage, such as disking or chiseling, that leaves crop residue on the surface helps to control soil blowing and water erosion. Terraces minimize the amount of water lost during periods of heavy rainfall. Water can be applied by sprinkler irrigation systems. Gravity irrigation systems also are suitable if areas are leveled or if a suitable grade is established so that excessive water erosion can be controlled.

This soil is suited to range. A cover of range plants is effective in controlling soil blowing. Overgrazing or improper haying methods reduce the amount of protective cover and the quality of native plants. Overgrazing also can result in the hazards of water erosion and soil blowing. Proper grazing use, timely deferment of grazing, and a planned grazing system help to keep the native plants in good condition.

This soil is suited to the trees and shrubs grown as windbreaks and to plantings that enhance recreational areas and wildlife habitat. The survival and growth rates of adapted species are good. Drought and weeds and grasses that compete with the trees for moisture are the main limitations. The weeds and undesirable grasses can be controlled by good site preparation, timely cultivation between the tree rows, or by applications of the appropriate herbicide. Irrigation can provide the moisture needed during dry periods.

The moderate permeability is a limitation on sites for septic tank absorption fields. It generally can be overcome by increasing the size of the field. The foundation of buildings should be strengthened and backfilled with coarse material to prevent the damage caused by shrinking and swelling. Roads built on this soil need to be designed so that the surface pavement and base material are thick enough to compensate for the low strength of the soil. Coarser grained base material can be used to ensure better performance.

The capability units are IIe-1, dryland, and IIe-4, irrigated; Silty range site; windbreak suitability group 3.

KeC—Keith loam, 3 to 6 percent slopes. This very deep, gently sloping, well drained soil is on uplands. It formed in loess. Areas are irregular in shape and range from 5 to more than 300 acres in size.

Typically, the surface layer is grayish brown, very friable loam about 6 inches thick. The subsoil is about 20 inches thick. The upper part is brown, friable silty clay loam, the next part is brown, friable silt loam, and the lower part is very pale brown, friable, calcareous silt loam. The underlying material is very pale brown silt loam to a depth of 60 inches. In a few small areas the surface soil is lighter in color and contains more clay.

Included with this soil in mapping are small areas of Sully soils. Sully soils do not have a mollic epipedon. They have less clay in the control section than the Keith soil. They are on the steeper slopes. They make up less than 10 percent of the map unit.

Permeability is moderate in the Keith soil, and the available water capacity is high. Runoff is slow or medium. The organic matter content is moderately low. The water intake rate also is moderately low.

Most of the acreage of this soil is used for cultivated crops. Some areas are irrigated if water is available. A few areas are used as range.

If dry-farmed, this soil is suited to winter wheat and corn and to grasses and legumes for hay and pasture. Water erosion and soil blowing are hazards in areas where the surface is not adequately protected by crops or crop residue. A system of conservation tillage, such as disking or chiseling, that leaves crop residue on the surface helps to control soil blowing and water erosion and conserve moisture. Channel terraces minimize the amount of water lost during periods of heavy rainfall and help to keep moisture on the fields for crops. Summer fallowing can help to increase the moisture supply needed for winter wheat. Returning crop residue to the soil helps to improve and maintain organic matter content, fertility, and tilth and increases the rate of water infiltration.

If irrigated, this soil is suited to corn, beans, alfalfa, and grasses. Soil blowing and water erosion are the principal hazards. A system of conservation tillage, such as disking or chiseling, that leaves crop residue on the surface helps to control soil blowing and water erosion. Terraces minimize the amount of water lost during periods of heavy rainfall. Water can be applied by sprinkler irrigation systems. Gravity irrigation systems also are suitable if areas are leveled or if a suitable grade is established so that excessive water erosion can be controlled.

This soil is suited to range. A cover of range plants is effective in controlling soil blowing. Overgrazing or improper haying methods reduce the amount of protective cover and the quality of native plants. Overgrazing also can result in the hazards of water erosion and soil blowing. Proper grazing use, timely deferment of grazing, and a planned grazing system help to keep the native plants in good condition.

This soil is suited to the trees and shrubs grown as windbreaks and to plantings that enhance recreational areas and wildlife habitat. The survival and growth rates of adapted species are good. Drought and weeds and grasses that compete with the trees for moisture are the main limitations. The weeds and undesirable grasses can be controlled by good site preparation, timely cultivation between the tree rows, or by applications of the appropriate herbicide. Irrigation can provide the moisture needed during dry periods.

The moderate permeability is a limitation on sites for septic tank absorption fields. It generally can be overcome by increasing the size of the field. The foundation of buildings should be strengthened and backfilled with coarse material to prevent the damage caused by shrinking and swelling. Roads built on this soil need to be designed so that the surface pavement and base material are thick enough to compensate for the low strength of the soil. Coarser grained base material can be used to ensure better performance.

The capability units are IIIe-1, dryland, and IIIe-4, irrigated; Silty range site; windbreak suitability group 3.

Ku—Kuma loam, 0 to 1 percent slopes. This very deep, nearly level, well drained soil is on uplands. It formed in loess over a buried soil that also formed in loess. Areas are irregular in shape and range from 5 to more than 1,000 acres in size. Some are large, broad tablelands.

Typically, the surface layer is dark grayish brown, friable loam about 5 inches thick. The subsoil is about 31 inches thick. It is dark grayish brown, firm silty clay loam in the upper part. A buried surface soil is at a depth of about 12 inches. It is dark grayish brown, friable silty clay loam in the upper part, dark grayish brown silty clay loam in the next part, and grayish brown silt loam in the lower part. The layer of accumulated lime is pale brown, calcareous loam. The underlying material to a depth of more than 60 inches is very pale brown and light gray loam. In some pedons the dark color of the surface layer is less than 20 inches thick.

Included with this soil in mapping are small areas of Lodgepole and Satanta soils. Lodgepole soils have more clay in the subsoil than the Kuma soil. They are in somewhat poorly drained depressions. Satanta soils have a mollic epipedon less than 20 inches thick. They have more sand in the control section than the Kuma soil. They are generally in landscape positions higher than those of the Kuma soil. Included soils make up less than 10 percent of the map unit.

Permeability is moderate in the Kuma soil, and the available water capacity is high. Runoff is slow. The organic matter content is moderate. The water intake rate is moderately low.

Most of the acreage of this soil is used for cultivated crops. Some areas are irrigated if water is available. A few small areas are used as range.

If dry-farmed, this soil is suited to winter wheat and corn and to grasses and legumes for hay and pasture. The lack of precipitation is the major limitation. Soil blowing is a slight hazard in areas where the surface is not adequately protected by crops or crop residue. A system of conservation tillage, such as disking or chiseling, that leaves crop residue on the surface helps to control soil blowing and conserve moisture. Summer fallowing can help to increase the moisture supply needed for winter wheat. Returning crop residue to the soil helps to improve and maintain organic matter content, fertility, and tilth and increases the rate of water infiltration.

If irrigated, this soil is suited to corn, beans, alfalfa, and grasses. Soil blowing is a slight hazard. A system of conservation tillage, such as disking or chiseling, that leaves crop residue on the surface helps to control soil blowing. Water can be applied by sprinkler irrigation systems. Gravity irrigation systems also are suitable if areas are leveled or if a suitable grade is established so that excessive water erosion can be controlled.

This soil is suited to range. A cover of range plants is effective in controlling soil blowing. Overgrazing or improper haying methods reduce the amount of protective cover and the quality of native plants. Overgrazing also can result in the hazards of water erosion and soil blowing. Proper grazing use, timely deferment of grazing, and a planned grazing system help to keep the native plants in good condition.

This soil is suited to the trees and shrubs grown as windbreaks and to plantings that enhance recreational areas and wildlife habitat. The survival and growth rates of adapted species are good. Drought and weeds and grasses that compete with the trees for moisture are the main limitations. The weeds and undesirable grasses can be controlled by good site preparation, timely cultivation between the tree rows, or by applications of the appropriate herbicide. Irrigation can provide the moisture needed during dry periods.

The moderate permeability is a limitation on sites for septic tank absorption fields. It generally can be overcome by increasing the size of the field. The

foundation of buildings should be strengthened and backfilled with coarse material to prevent the damage caused by shrinking and swelling. Roads built on this soil need to be designed so that the surface pavement and base material are thick enough to compensate for the low strength of the soil. Coarser grained base material can be used to ensure better performance.

The capability units are IIc-1, dryland, and I-4, irrigated; Silty range site; windbreak suitability group 3.

KuB—Kuma loam, 1 to 3 percent slopes. This very deep, very gently sloping, well drained soil is on uplands. It formed in loess over a buried soil that also formed in loess. Areas are irregular in shape and range from 5 to more than 1,000 acres in size. Some are large, broad tablelands.

Typically, the surface layer is dark grayish brown, friable loam about 6 inches thick. The subsoil is 35 inches thick. The upper part is dark grayish brown, friable silty clay loam, the next part is brown and dark grayish brown silty clay loam, and the lower part is grayish brown, friable silt loam. The underlying material to a depth of more than 60 inches is pale brown, calcareous loam. In some pedons the dark color of the surface layer is less than 20 inches thick.

Included with this soil in mapping are small areas of Lodgepole and Satanta soils. Lodgepole soils have more clay in the subsoil than the Kuma soil. They are in somewhat poorly drained depressions. Satanta soils have a mollic epipedon less than 20 inches thick. They have more sand in the control section than the Kuma soil. They are in landscape positions higher than those of the Kuma soil. Included soils make up less than 10 percent of the map unit.

Permeability is moderate in the Kuma soil, and the available water capacity is high. Runoff is slow. The organic matter content is moderate. The water intake rate is moderately low.

Most of the acreage of this soil is used for cultivated crops. Some areas are irrigated if water is available. A few small areas are used as range.

If dry-farmed, this soil is suited to winter wheat and corn and to grasses and legumes for hay and pasture. The lack of precipitation is a limitation. Water erosion and soil blowing are slight hazards in areas where the surface is not adequately protected by crops or crop residue. A system of conservation tillage, such as disking or chiseling, that leaves crop residue on the surface helps to control soil blowing and conserve moisture. Channel terraces minimize the amount of water lost during periods of heavy rainfall and help to keep moisture on the fields for crops. Summer fallowing can help to increase the moisture supply needed for winter wheat. Returning crop residue to the soil helps to improve and maintain organic matter content, fertility, and tilth and increases the rate of water infiltration.

If irrigated, this soil is suited to corn, beans, alfalfa, and grasses. Water erosion and soil blowing are the principal hazards. A system of conservation tillage, such as disking or chiseling, that leaves crop residue on the surface helps to control soil blowing. Terraces minimize the amount of water lost during periods of heavy rainfall. Water can be applied by sprinkler irrigation systems. Gravity irrigation systems also are suitable if areas are leveled or if a suitable grade is established so that excessive water erosion can be controlled.

This soil is suited to range. A cover of range plants is effective in controlling soil blowing. Overgrazing or improper haying methods reduce the amount of protective cover and the quality of native plants. Overgrazing also can result in the hazards of water erosion and soil blowing. Proper grazing use, timely deferment of grazing, and a planned grazing system help to keep the native plants in good condition.

This soil is suited to the trees and shrubs grown as windbreaks and to plantings that enhance recreational areas and wildlife habitat. The survival and growth rates of adapted species are good. Drought and weeds and grasses that compete with the trees for moisture are the main limitations. The weeds and undesirable grasses can be controlled by good site preparation, timely cultivation between the tree rows, or by applications of the appropriate herbicide. Irrigation can provide the moisture needed during dry periods.

The moderate permeability is a limitation on sites for septic tank absorption fields. It generally can be overcome by increasing the size of the field. The foundation of buildings should be strengthened and backfilled with coarse material to prevent the damage caused by shrinking and swelling. Roads built on this soil need to be designed so that the surface pavement and base material are thick enough to compensate for the low strength of the soil. Coarser grained base material can be used to ensure better performance.

The capability units are IIe-1, dryland, and IIe-4, irrigated; Silty range site; windbreak suitability group 3.

La—Lawet loam, 0 to 2 percent slopes. This very deep, nearly level, poorly drained soil is on high bottom land. It formed in loamy eolian or alluvial sediments. It is subject to rare flooding. Areas range from 3 to 80 acres in size.

Typically, the surface layer is gray, friable, calcareous loam about 10 inches thick. The subsurface layer is gray, friable, calcareous sandy clay loam about 10 inches thick. The layer of accumulated lime also is gray, friable, calcareous sandy clay loam. It is about 6 inches thick. The underlying material to a depth of 60

inches or more is gray and light brownish gray, calcareous sandy clay loam. In some areas the dark upper layers are more than 20 inches thick.

Included with this soil in mapping are small areas of Boel and Janise soils. Boel and Janise soils are somewhat poorly drained. Boel soils have more sand in the control section than the Lawet soil. They are in landscape positions higher than those of the Lawet soil. Janise soils are highly alkaline. They are in landscape positions slightly higher than those of the Lawet soil. Included soils make up less than 10 percent of the map unit.

Permeability is moderate or moderately slow in the Lawet soil, and the available water capacity is high. Runoff is very slow. The organic matter content is high. The seasonal high water table ranges from a depth of about 1 foot during wet years to about 2 feet during dry years.

Most of the acreage of this soil supports native grasses and is used as hayland. Some small areas are used as pasture during dry periods. This soil is not suitable as cropland because it is too wet.

If this soil is used as range or hayland, the climax vegetation is dominantly big bluestem, northern reedgrass, indiangrass, prairie cordgrass, switchgrass, sedges, and rushes. These species make up 60 percent or more of the total annual forage. Plains bluegrass, slender wheatgrass, bluejoint reedgrass, and forbs make up the rest. If subject to continuous heavy grazing or improperly harvested for hay, big bluestem, indiangrass, switchgrass, and prairie cordgrass decrease in abundance and are replaced by slender wheatgrass and sedges. If overgrazing or improper haying methods continue for many years, plains bluegrass, sedges, rushes, and forbs dominate the site.

If the range is in excellent condition, the suggested initial stocking rate is 1.8 animal unit months per acre. A planned grazing system that includes proper grazing use, timely deferment of grazing and haying, and restricted use during very wet periods helps to maintain or improve the range condition. This soil is generally the first to be overgrazed when it is in a pasture that includes better drained, sandy soils. Properly located fences and livestock watering and salting facilities result in a more uniform distribution of grazing. Grazing and heavy machinery traffic when the soil is wet can result in surface compaction and the formation of small mounds and ruts, which make grazing and harvesting hay difficult.

If this soil is used as hayland, mowing should be regulated so that the grasses remain vigorous. The hay is of best quality when the grasses are cut early. After the ground is frozen, livestock can graze without damaging the meadows. They should be removed in spring, before the ground thaws and the water table rises.

This soil is suited to the trees and shrubs grown as windbreaks and to plantings that enhance recreational areas and wildlife habitat. Trees and shrubs that can withstand the wetness survive and grow well. Cultivating and planting during wet years may be delayed until the soil has begun to dry.

This soil in not suited to septic tank absorption fields because of the wetness. A suitable alternative site should be selected. Constructing dwellings on raised, well compacted fill material helps to overcome the wetness. Constructing roads on suitable, well compacted fill material, providing adequate roadside ditches, and installing culverts help to prevent the road damage caused by wetness. The damage to roads caused by frost action can be minimized by a good surface drainage system and by a gravel moisture barrier in the subgrade. Crowning the road by grading and constructing adequate roadside ditches help to provide the needed surface drainage.

The capability unit is Vw-7, dryland; Wet Subirrigated range site; windbreak suitability group 2D.

Le—Lex loam, 0 to 2 percent slopes. This very deep, nearly level, somewhat poorly drained soil is on high bottom land. It formed in 20 to 40 inches of loamy alluvium over gravelly coarse sand. It is subject to rare flooding. Areas are long and parallel to the streams. They range from 5 to several hundred acres in size.

Typically, the surface soil is gray, calcareous, friable loam about 11 inches thick. Next is a transitional layer of gray, calcareous, friable silty clay loam about 8 inches thick. The underlying material extends to a depth of 60 inches or more. It is gray fine sandy loam in the upper part and light gray gravelly sand in the lower part. In some areas, the dark upper layers are more than 24 inches thick and the depth to gravelly coarse sand is more than 40 inches.

Included with this soil in mapping are small areas of Alda and Wann soils. Alda and Wann soils are in landscape positions similar to those of the Lex soil. They have less clay in the control section than the Lex soil. Wann soils do not have coarse material above a depth of 40 inches. Included soils make up less than 10 percent of the map unit.

Permeability is moderate or moderately slow in the solum of the Lex soil and very rapid in the underlying material. The available water capacity is moderate. Runoff is slow. The organic matter content is moderate. The water intake rate also is moderate. The seasonal high water table ranges from a depth of about 1.5 feet during wet years to about 3.0 feet during dry years.

Most of the acreage of this soil is used for irrigated

crops. Corn and alfalfa are the main crops in these areas. The remaining acreage is used as hayland or pasture.

If dry-farmed or irrigated, this soil is suited to alfalfa, corn, and grasses. The flooding is a hazard. Constructing dams, dikes, and diversion terraces helps to control flooding. Wetness is a limitation. It sometimes delays tilling and planting in the spring. Returning crop residue to the soil and applying barnyard manure help to improve and maintain organic matter content, fertility, and tilth and increase the rate of water infiltration.

This soil is suited to range and native hay. Continuous heavy grazing or improper haying methods reduce the amount of protective cover and the quality of native plants. Overgrazing when the soil is wet can result in surface compaction and the formation of small mounds, which make grazing and harvesting hay difficult. Proper grazing use, timely deferment of grazing and haying, and restricted use during wet periods help to keep the native plants in good condition.

This soil is suited to the trees and shrubs grown as windbreaks and to plantings that enhance recreational areas and wildlife habitat. Trees and shrubs that can withstand the wetness survive and grow well. Weeds and undesirable grasses that compete with the trees for moisture and establishment of seedlings during wet years are problems. Plant competition between the tree rows can be controlled by timely cultivation with conventional equipment and by careful applications of the appropriate herbicide. Cultivating and planting during wet years may be delayed until the soil has begun to dry.

The moderate permeability and the flooding are limitations on sites for septic tank absorption fields. The restricted permeability generally can be overcome by increasing the size of the field. If this soil is used as a site for septic tank absorption fields, fill material is needed to raise the absorption field a sufficient distance above the seasonal high water table. Constructing dwellings on raised, well compacted fill material helps to prevent the damage caused by flooding and wetness. Constructing roads on suitable, well compacted fill material above the flood level, providing adequate roadside ditches, and installing culverts help to prevent the road damage caused by flooding and wetness. The damage to roads caused by frost action can be minimized by a good surface drainage system and by a gravel moisture barrier in the subgrade. Crowning the road by grading and construction of adequate roadside ditches help to provide the needed surface drainage.

The capability units are IIIw-4, dryland, and IIIw-7, irrigated; Subirrigated range site; windbreak suitability group 2S.

Lp—Lodgepole silt loam, 0 to 1 percent slopes. This very deep, nearly level, somewhat poorly drained soil is in potholes on uplands. It formed in loess. It is subject to ponding. Areas range from 5 to 30 acres in size.

Typically, the surface layer is gray, friable silt loam about 7 inches thick. The subsoil is about 53 inches thick. It is dark gray, very firm silty clay loam in the upper part, gray, very firm silty clay loam in the next part, and brown, firm silty clay loam in the lower part. In some areas the subsoil is silty clay. Some pedons have a subsurface layer of gray or light gray silt loam.

Permeability is very slow in the Lodgepole soil, and the available water capacity is high. Runoff is ponded. The organic matter content is moderate. The water intake rate is low. The perched water table ranges from a depth of about 0.5 foot above the surface during wet years to about 1.0 foot during dry years.

More than half the acreage of this soil is used for dryland crops and the rest is used as pasture. Crops can be grown during some years when the amount of annual rainfall is below normal. During years when the amount of rainfall is normal to above average, the soil will be covered by water.

This soil is poorly suited to both dryland and irrigated crops because of ponding. The wetness caused by ponding often delays tillage and cultivation early in the spring. Because areas planted to winter wheat, forage sorghum, and introduced grasses do not need to be tilled in early spring, these crops are somewhat suited to this soil. Returning crop residue to the soil and avoiding tilling when wet can help to maintain good tilth.

This soil is suited to range and hayland. Continuous heavy grazing or improper haying methods reduce the amount of protective cover and the quality of native plants. Proper grazing use, timely deferment of grazing and haying, and a planned grazing system help to keep the native plants in good condition.

This soil is suited to the trees and shrubs grown as windbreaks and to plantings that enhance recreational areas and wildlife habitat. Trees and shrubs that can withstand the wetness survive and grow well. In wet years cultivating and planting needs to be delayed until the soil is sufficiently dry. Constructing dikes or terraces on the adjacent soils helps to prevent the ponding.

This soil is not suited to septic tank absorption fields because of the wetness and very slow permeability and to dwellings because of the ponding. A suitable alternative site should be selected. Constructing roads on suitable, well compacted fill material above the level of ponding, providing adequate roadside ditches, and installing culverts help to prevent the road damage caused by ponding. Roads built on this soil need to be designed so that the surface pavement and base

material are thick enough to compensate for the low strength of the soil. Coarser grained base material can be used to ensure better performance. Mixing the base material with additives, such as hydrated lime, can help prevent shrinking and swelling.

The capability units are IIIw-2, dryland, and IVw-2, irrigated; Clayey Overflow range site; windbreak suitability group 2W.

Ma—Marlake fine sandy loam, 0 to 1 percent slopes. This very deep, nearly level, very poorly drained soil is in swales in sandhill valleys and in swales bordering lakes and streams. It formed in sandy eolian material and sandy and loamy alluvium. It is subject to ponding. Areas range from 5 to 80 acres.

Typically, the surface layer is covered with about 2 inches of partly decomposed grass litter. It is gray, very friable fine sandy loam about 8 inches thick. The underlying material to a depth of 60 inches or more is light gray fine sand that has strata of fine sandy loam and loamy sand. In some places the surface layer and underlying material have less sand and more silt than is typical. Strata of finer or coarser textured material and dark buried horizons are common. Some pedons have an accumulation of calcium carbonate in the upper part of the underlying material.

Included with this soil in mapping are small areas of Cullison soils. Cullison soils have a slightly lower water table than the Marlake soil. They have a mollic epipedon. They have more carbonates in the control section than the Marlake soil. Also, they are slightly higher on the landscape. Included soils make up less than 10 percent of the map unit.

Permeability is rapid in the Marlake soil, and the available water capacity is low. Runoff is ponded. The organic matter content is high. The seasonal high water table ranges from a depth of about 2 feet above the surface during wet years to about 1 foot during dry years.

All of the acreage of this soil is covered with a thick growth of cattails, rushes, and willows. The soil is used as habitat for wetland wildlife.

This soil is not suited to farmland or range or to the trees grown as windbreaks because of the wetness and the ponding. It is suited to the wetland plants that provide food and cover for wildlife.

This soil is unsuited to septic tank absorption fields, dwellings, and roads. A suitable alternative site should be selected.

The capability unit is VIIIw-7, dryland; windbreak suitability group 10. No range site is assigned.

Me—Merrick loam, 0 to 2 percent slopes. This very deep, nearly level, moderately well drained soil is on high bottom land. It formed in silty and loamy alluvium. It is subject to rare flooding. Areas range from 10 to 400 acres in size.

Typically, the surface layer is dark grayish brown, friable loam about 8 inches thick. The subsurface layer is dark gray, friable loam about 17 inches thick. The underlying material extends to a depth of more than 60 inches. It is grayish brown clay loam in the upper part and mottled, calcareous, grayish brown clay loam and loam in the lower part. In some areas sandy, gravelly, or clayey strata are below a depth of about 40 inches.

Included with this soil in mapping are small areas of Bayard and Duroc soils. Bayard and Duroc soils are well drained. They are in landscape positions higher than those of the Merrick soil. Bayard soils have less clay in the control section than the Merrick soil. Duroc soils have less sand in the control section than the Merrick soil. They have a mollic epipedon more than 20 inches thick. Included soils make up 5 to 15 percent of the map unit.

Permeability is moderate in the Merrick soil, and the available water capacity is high. Runoff is slow. The organic matter content is moderate. The water intake rate also is moderate. The seasonal high water table ranges from a depth of about 4 feet during wet years to about 6 feet during dry years.

Most of the acreage of this soil is used for irrigated crops. Corn is the principal crop in these areas. The remaining acreage is used as pasture.

If dry-farmed, this soil is suited to wheat and alfalfa. The flooding is a hazard. The lack of precipitation is the major limitation. Soil blowing is a slight hazard in areas where the surface is not adequately protected by crops or crop residue. A system of conservation tillage, such as summer fallowing, disking, or chiseling, helps to increase the moisture supply in the subsoil and to control soil blowing.

If irrigated, this soil is suited to corn, alfalfa, and beans. The flooding is a hazard. Water can be applied by gravity and sprinkler irrigation systems. Efficient management of the irrigation water is needed. Soil blowing is a slight hazard. A system of conservation tillage, such as disking or chiseling, helps to control soil blowing. Returning crop residue to the soil and applying barnyard manure help to improve and maintain organic matter content, fertility, and tilth and increase the rate of water infiltration.

This soil is suited to range and hayland. A cover of range plants is effective in controlling soil blowing. Overgrazing or improper haying methods reduce the amount of protective cover and the quality of native plants. Proper grazing use, timely deferment of grazing and haying, and a planned grazing system help to keep the native plants in good condition.

This soil is suited to the trees and shrubs grown as windbreaks and to plantings that enhance recreational areas and wildlife habitat. The survival and growth rates of adapted species are good. Weeds and grasses that compete with the trees for moisture are the main limitation. The weeds and undesirable grasses can be controlled by good site preparation, timely cultivation between the tree rows, or by applications of the appropriate herbicide. Irrigation can provide the moisture needed during dry periods.

If this soil is used as a site for septic tank absorption fields, fill material is needed to raise the absorption field a sufficient distance above the seasonal high water table. The moderate permeability is a limitation on sites for septic tank absorption fields. It generally can be overcome by increasing the size of the field. Constructing dwellings on raised, well compacted fill material helps to prevent the damage caused by flooding and wetness. Roads constructed in areas of this soil need to be designed so that the surface pavement and base material are thick enough to compensate for the low strength of the soil. Coarser grained base material can be used to ensure better performance. Constructing roads on suitable, well compacted fill material above the flood level, providing adequate roadside ditches, and installing culverts help to prevent the road damage caused by flooding and wetness.

The capability units are IIc-1, dryland, and I-6, irrigated; Silty Lowland site; windbreak suitability group 1. No range site is assigned.

No—Norwest loam, 0 to 2 percent slopes. This very deep, nearly level, somewhat poorly drained soil is on high bottom land. It formed in loamy, calcareous alluvium. It is subject to rare flooding. Areas are commonly long and narrow and range from 5 to several hundred acres in size.

Typically, the surface layer is dark gray, calcareous loam about 7 inches thick. The subsurface layer is dark gray and gray, calcareous loam about 8 inches thick. The subsoil is light gray, calcareous loam about 19 inches thick. The underlying material extends to a depth of more than 60 inches. It is mottled, calcareous very fine sandy loam in the upper part and stratified, mottled, calcareous clay loam and loamy sand in the lower part. In some areas the dark upper layers are more than 20 inches thick. In other areas the calcic horizon is more than 15 inches below the surface.

Included with this soil in mapping are small areas of Alda, Lex, and Wann soils. These soils are in landscape positions similar to those of the Norwest soil. Alda and Wann soils have less clay in the control section than the Norwest soil. Alda soils have coarse sand at a depth of 20 to 40 inches. Lex soils have gravelly coarse sand at a depth of 20 to 40 inches. Included soils make up less than 10 percent of the map unit.

Permeability is moderate in the Norwest soil, and the available water capacity is high. Runoff is slow. The organic matter content is moderate. The water intake rate also is moderate. The seasonal high water table ranges from a depth of about 1.5 feet during wet years to about 3.0 feet during dry years.

Most of the acreage of this soil is used for irrigated crops. Corn and alfalfa are the main crops in these areas. The remaining acreage is used as hayland or pasture.

If dry-farmed or irrigated, this soil is suited to alfalfa, corn, and grasses. The flooding is a hazard. Constructing dams, dikes, and diversion terraces helps to control flooding. Returning crop residue to the soil and applying barnyard manure help to improve and maintain organic matter content, fertility, and tilth and increase the rate of water infiltration.

This soil is suited to range and native hay. Continuous heavy grazing or improper haying methods reduce the amount of protective cover and the quality of native plants. Overgrazing when the soil is wet can result in surface compaction and the formation of small mounds, which make grazing and harvesting hay difficult. Proper grazing use, timely deferment of grazing and haying, and restricted use during wet periods help to keep the native plants in good condition.

This soil is suited to the trees and shrubs grown as windbreaks and to plantings that enhance recreational areas and wildlife habitat. Trees and shrubs that can withstand the wetness survive and grow well. Weeds and undesirable grasses that compete with the trees for moisture and establishment of seedlings during wet years are problems. Plant competition between the tree rows can be controlled by timely cultivation with conventional equipment and by careful applications of the appropriate herbicide. Cultivating and planting during wet years may be delayed until the soil has begun to dry.

The flooding is a hazard on sites for septic tank absorption fields. If this soil is used as a site for septic tank absorption fields, fill material is needed to raise the absorption field a sufficient distance above the seasonal high water table. Constructing dwellings on raised, well compacted fill material help to prevent the damage caused by flooding and wetness. Constructing roads on suitable, well compacted fill material above the flood level, providing adequate roadside ditches, and installing culverts help to prevent the road damage caused by flooding and wetness. The damage to roads caused by frost action can be minimized by a good surface drainage system and by a gravel moisture

barrier in the subgrade. Crowning the road by grading and construction of adequate roadside ditches help to provide the needed surface drainage.

The capability units are IIIw-4, dryland, and IIIw-6, irrigated; Subirrigated range site; windbreak suitability group 2S.

Pp—Pits and dumps. This map unit consists mainly of deep, gently sloping and steep mounds of gravel, sand, and overburden and the adjacent pits on bottom land and stream terraces. The pits typically contain water. The areas of sand and gravel are excessively drained. The dumps in areas of the bottom land are subject to rare flooding. Areas range from 2 to 125 acres in size.

Typically, the material in this unit consists of medium and fine sand and some gravel. A soil profile has not developed.

Included with this unit in mapping are small areas of Gothenburg soils. These soils are in landscape positions lower than the mounds of sand but higher than the pits. They make up 10 to 25 percent of the map unit.

Permeability is rapid or very rapid in this map unit, and the available water capacity is very low. Runoff is very slow. The organic matter content is very low. The water level in the pits generally is 5 to 10 feet lower than the adjacent surface. The mounds generally support no vegetation.

Most of the acreage of this map unit is commercially mined for sand and gravel. Some places that are no longer mined are used as wildlife habitat or recreational areas. Other places are used as dumps for garbage disposal and are backfilled with sand and gravel.

This unit is not suited to farming because of droughtiness and the slope.

Pits are not suited to range because of windblown sand and the slope. Sparse vegetation gradually becomes established in some places where sand and gravel are no longer mined. Land shaping can be used in areas that have a steep slope.

This unit generally is not suited to the trees and shrubs grown as windbreaks because of droughtiness and windblown sand.

The material in this map unit readily absorbs but does not adequately filter the effluent in septic tank absorption fields. The poor filtering capacity can result in pollution of underground water supplies. The sides of shallow excavations can cave in unless they are shored. This map unit is not suited to dwellings because of the flooding. A suitable alternative site should be selected. Cutting and filling are needed to provide a suitable grade for roads.

The capability unit is VIIIs-8, dryland; windbreak suitability group 10. No range site is assigned.

Pt—Platte loam, 0 to 2 percent slopes. This very deep, nearly level, somewhat poorly drained soil is on low bottom land. It formed in 10 to 20 inches of sandy and loamy alluvium over gravelly coarse sand. It is occasionally flooded. Areas are commonly long and parallel to the rivers. They range from 5 to more than 200 acres in size.

Typically, the surface layer is dark gray, friable loam about 5 inches thick. Next is a transitional layer of light brownish gray, very friable fine sandy loam about 6 inches thick. The underlying material extends to a depth of 60 inches or more. It is pale brown fine sandy loam in the upper part and pale brown gravelly coarse sand in the lower part. In some areas the dark upper layers are more than 10 inches thick.

Included with this soil in mapping are small areas of Alda and Gothenburg soils. Alda soils have coarse sand at a depth of 20 to 40 inches. They are in landscape positions slightly higher than those of the Platte soil. Gothenburg soils have gravelly coarse sand above a depth of 10 inches. They are in landscape positions lower than those of the Platte soil. Included soils make up less than 10 percent of the map unit.

Permeability is moderate in the solum of the Platte soil and very rapid in the underlying material. The available water capacity is low. Runoff is slow. The organic matter content is moderately low. The water intake rate is moderate. The seasonal high water table ranges from a depth of about 1 foot during wet years to about 2 feet during dry years.

Most of the acreage of this soil supports native grasses and is used as pasture or hayland. A few small areas are irrigated with center-pivot irrigation systems. Corn and alfalfa are the principal crops in these areas.

This soil generally is unsuited to dryland farming.

If irrigated by sprinklers, this soil is poorly suited to cropland. The wetness often delays tilling and cultivating early in the spring. The major hazard is flooding following periods of heavy rainfall. The flooding, however, is very brief and seldom causes severe crop damage. Because the available water capacity of this soil is low, small, frequent applications of irrigation water are needed.

If this soil is used as range or hayland, the climax vegetation is dominantly big bluestem, little bluestem, indiangrass, switchgrass, sedges, and rushes. These species make up 75 percent or more of the total annual forage. Prairie cordgrass and forbs make up the rest. If subject to continuous heavy grazing or improperly harvested for hay, big bluestem, little bluestem, indiangrass, switchgrass, and prairie cordgrass decrease in abundance and are replaced by western

wheatgrass, slender wheatgrass, green muhly, sedges, and rushes. If overgrazing or improper haying methods continue for many years, sedges, rushes, and forbs dominate the site.

If the range is in excellent condition, the suggested initial stocking rate is 1.6 animal unit months per acre. A planned grazing system that includes proper grazing use, timely deferment of grazing and haying, and restricted use during wet periods helps to maintain or improve the range condition. This soil is generally the first to be overgrazed when it is in a pasture that includes better drained, sandy soils. Properly located fences and livestock watering and salting facilities result in a more uniform distribution of grazing. Areas previously used as cropland should be reseeded to a suitable grass mixture if they are used as range.

If this soil is used as hayland, mowing should be regulated so that the grasses remain vigorous. The hay is of best quality when the grasses are cut early. After the ground is frozen, livestock can graze without damaging the meadows. They should be removed in spring, before the ground thaws.

This soil is suited to the trees and shrubs grown as windbreaks and to plantings that enhance recreational areas and wildlife habitat. Trees and shrubs that can withstand the wetness survive and grow well. Weeds and undesirable grasses that compete with the trees for moisture, a lack of seasonal rainfall, and soil blowing that damages seedlings are limitations. The weeds and undesirable grasses can be controlled by timely cultivation or by applications of the appropriate herbicide. Irrigation can provide the moisture needed during dry periods. Soil blowing can be controlled by planting a cover crop between the tree rows.

This soil is not suited to septic tank absorption fields because of the flooding, wetness, and a poor filtering capacity. A suitable alternative site should be selected. This soil is not suited to dwellings because of the flooding. A suitable alternative site should be selected. Constructing roads on suitable, well compacted fill material above the flood level, providing adequate roadside ditches, and installing culverts help to prevent the road damage caused by flooding and wetness.

The capability units are VIw-4, dryland, and IVw-13, irrigated; Subirrigated range site; windbreak suitability group 2S.

RtB—Rosebud loam, 1 to 3 percent slopes. This moderately deep, very gently sloping, well drained soil is on uplands. It formed in calcareous, loamy material that weathered from soft, very fine grained sandstone bedrock. Areas range from 5 to 80 acres in size.

Typically, the surface layer is grayish brown, very friable loam about 6 inches thick. The subsoil is about 24 inches thick. The upper part is dark grayish brown, firm clay loam, the next part is pale brown, friable loam, and the lower part is light gray, friable loam. White, calcareous, very fine grained sandstone bedrock is at a depth of about 30 inches. In a few small areas the surface layer is fine sandy loam.

Included with this soil in mapping are small areas of Satanta soils. Satanta soils are very deep. They are in landscape positions similar to those of the Rosebud soil. Included soils make up 8 to 15 percent of the map unit.

Permeability and the available water capacity are moderate in the Rosebud soil. Runoff is medium. The organic matter content is moderate. The water intake rate also is moderate.

Most of the acreage of this soil is used for cultivated crops. Some areas are irrigated if water is available. A few areas are used as pasture or range.

If dry-farmed, this soil is suited to wheat. Introduced grasses can be grown for hay or pasture. Water erosion and soil blowing are the major hazards in areas where the surface is not adequately protected by crops or crop residue. Insufficient rainfall during the growing season and the moderately deep rooting depth are limitations. A system of conservation tillage, such as terracing, chiseling, or disking, that leaves crop residue on the surface helps to control water erosion and soil blowing and conserve moisture. Leaving crop residue on the soil, planting green manure crops, and applying feedlot manure help to improve and maintain organic matter content and fertility. Summer fallowing is needed if wheat is grown.

If irrigated, this soil is suited to corn, beans, and alfalfa and to introduced grasses for hay or pasture. The major limitation is the moderately deep rooting depth. Soil blowing and water erosion are hazards in areas where the surface is not adequately protected by crops or crop residue. A system of conservation tillage, such as chiseling or disking, that leaves crop residue on the surface helps to control water erosion and soil blowing and conserve moisture. Leaving crop residue on the soil, planting green manure crops, and applying feedlot manure help to improve and maintain organic matter content and fertility and increase the rate of water infiltration.

This soil is suited to range. A cover of range plants is effective in controlling soil blowing. Overgrazing or improper haying methods reduce the amount of protective cover and the quality of native plants. Overgrazing also can result in the hazards of water erosion and soil blowing. Proper grazing use, timely deferment of grazing, and a planned grazing system help to keep the native plants in good condition.

This soil is suited to the trees and shrubs grown as

windbreaks and to plantings that enhance recreational areas and wildlife habitat. The survival and growth rates of adapted species are fair. Drought and weeds and grasses that compete with the trees for moisture are the main limitations. The weeds and undesirable grasses can be controlled by good site preparation, timely cultivation between the tree rows, or by applications of the appropriate herbicide. Irrigation can provide the moisture needed during dry periods.

Building up or mounding sites for septic tank absorption fields with suitable fill material can increase the filtering capacity of the soil. The soft bedrock generally can be easily excavated during the construction of houses with basements or buildings that have deep foundations. The damage to roads caused by frost action can be minimized by a good surface drainage system. Crowning the road by grading and constructing adequate roadside ditches help to provide the needed surface drainage.

The capability units are IIIe-1, dryland, and IIIe-4, irrigated; Silty range site; windbreak suitability group 6R.

RtD—Rosebud loam, 3 to 9 percent slopes. This moderately deep, gently sloping and strongly sloping, well drained soil is on uplands. It formed in calcareous, loamy material that weathered from soft, very fined grained sandstone bedrock. Areas range from 5 to 80 acres in size.

Typically, the surface soil is dark grayish brown, very friable loam about 11 inches thick. The subsoil is about 12 inches thick. The upper part is brown, firm clay loam, and the lower part is light gray, calcareous loam. The underlying material extends to a depth of more than 60 inches. It is calcareous sandy loam in the upper part and very pale brown, calcareous very fine grained sandstone bedrock in the lower part. In a few small areas the surface layer is fine sandy loam.

Included with this soil in mapping are small areas of Satanta soils. Satanta soils are very deep. They are in landscape positions similar to those of the Rosebud soil. Included soils make up 8 to 15 percent of the map unit.

Permeability and the available water capacity are moderate in the Rosebud soil. Runoff is medium. The organic matter content is moderate. The water intake rate also is moderate.

Most of the acreage of this soil is used for cultivated crops. Some areas are irrigated if water is available. A few areas are used as pasture or range.

If dry-farmed, this soil is suited to wheat. Introduced grasses can be grown for hay or pasture. The major hazards are water erosion and soil blowing in areas where the surface is not adequately protected by crops or crop residue. Insufficient rainfall during the growing season and the moderately deep rooting depth are limitations. A system of conservation tillage, such as terracing, chiseling, or disking, that leaves crop residue on the surface helps to control water erosion and soil blowing and conserve moisture. Leaving crop residue on the soil, planting green manure crops, and applying feedlot manure help to improve and maintain organic matter content and fertility. Summer fallowing is needed if wheat is grown.

If irrigated, this soil is suited to corn, beans, and alfalfa and to introduced grasses for hay or pasture. The major limitation is the moderately deep rooting depth. Soil blowing and water erosion are hazards in areas where the surface is not adequately protected by crops or crop residue. A system of conservation tillage, such as chiseling or disking, that leaves crop residue on the surface helps to control water erosion and soil blowing and conserve moisture. Leaving crop residue on the soil, planting green manure crops, and applying feedlot manure help to improve and maintain organic matter content and fertility and increase the rate of water infiltration.

This soil is suited to range. A cover of range plants is effective in controlling soil blowing. Overgrazing or improper haying methods reduce the amount of protective cover and the quality of native plants. Overgrazing also can result in the hazards of water erosion and soil blowing. Proper grazing use, timely deferment of grazing, and a planned grazing system help to keep the native plants in good condition.

This soil is suited to the trees and shrubs grown as windbreaks and to plantings that enhance recreational areas and wildlife habitat. The survival and growth rates of adapted species are fair. Drought and weeds and grasses that compete with the trees for moisture are the main limitations. The weeds and undesirable grasses can be controlled by good site preparation, timely cultivation between the tree rows, or by applications of the appropriate herbicide. Irrigation can provide the moisture needed during dry periods.

Building up or mounding sites for septic tank absorption fields with suitable fill material can increase the filtering capacity of the soil. The soft bedrock generally can be easily excavated during the construction of houses with basements or buildings that have deep foundations. The damage to roads caused by frost action can be minimized by a good surface drainage system. Crowning the road by grading and constructing adequate roadside ditches help to provide the needed surface drainage.

The capability units are IVe-1, dryland, and IVe-4, irrigated; Silty range site; windbreak suitability group 6R.

SaB—Sarben loamy fine sand, 0 to 3 percent slopes. This very deep, nearly level and very gently sloping, well drained soil is on uplands. It formed in sandy and loamy eolian material. Areas range from 5 to 100 acres in size.

Typically, the surface layer is grayish brown, very friable loamy fine sand about 6 inches thick. Next is a transitional layer of brown loamy very fine sand about 3 inches thick. The underlying material extends to a depth of 60 inches or more. It is brown loamy very fine sand in the upper part and calcareous, pale brown loamy very fine sand in the lower part. In some places the dark surface layer is more than 10 inches thick.

Included with this soil in mapping are small areas of Satanta and Vetal soils. Satanta soils have a mollic epipedon. They have more clay in the control section than the Sarben soil. They are in landscape positions lower than those of the Sarben soil. Vetal soils have a mollic epipedon more than 20 inches thick. They are in swales below the Sarben soil. Included soils make up less than 10 percent of the map unit.

Permeability is moderately rapid in the Sarben soil, and the available water capacity is high. Runoff is slow. The organic matter content is low. The water intake rate is high.

Most of the acreage of this soil is used for cultivated crops. Some areas are irrigated if water is available. A few areas are used as pasture or range.

If dry-farmed, this soil is suited to corn and winter wheat and to grasses and legumes for hay and pasture. Soil blowing is a severe hazard. The low fertility is a limitation. A system of conservation tillage, such as disking or chiseling, helps to conserve moisture and control soil blowing. Incorporating crop residue into the plow layer helps to improve and maintain organic matter content, fertility, and tilth. Applications of fertilizers also improve fertility.

If irrigated by sprinklers, this soil is suited to corn, alfalfa, winter wheat, and introduced grasses. Soil blowing is a severe hazard. It can be controlled by leaving crop residue on the surface. Incorporating crop residue into the plow layer helps to improve and maintain organic matter content, fertility, and tilth. This soil is suited to gravity irrigation in areas where the slope is 0 to 1.5 percent and the maximum length of the run is 300 to 500 feet. The high water intake rate is a limitation affecting the length of the run. Soil blowing is a severe hazard during the spring. It can be overcome by leaving crop residue on the surface. Incorporating crop residue and green manure crops into the plow layer helps to improve and maintain organic matter content, fertility, and tilth.

This soil is suited to range. A cover of range plants is effective in controlling soil blowing. Overgrazing or improper haying methods reduce the amount of protective cover and the quality of native plants. As a result, water erosion and soil blowing are excessive and small blowouts can form. Proper grazing use, timely deferment of grazing and haying, and a planned grazing system help to keep the native plants in good condition. Range seeding may be needed to stabilize severely eroded areas of cropland.

This soil is suited to the trees and shrubs grown as windbreaks and to plantings that enhance recreational areas and wildlife habitat. The survival and growth rates of adapted species are fair. The lack of seasonal rainfall and soil blowing are hazards. Soil blowing can be controlled by maintaining strips of sod or cover crops between the tree rows. Irrigation can provide the moisture needed during dry periods. Hoeing by hand, rototilling, and applying the appropriate herbicide help to control plant competition in the tree rows.

This soil generally is suited to septic tank absorption fields, dwellings, and roads. The sides of shallow excavations can cave in unless they are shored.

The capability units are IVe-5, dryland, and IIIe-10, irrigated; Sandy range site; windbreak suitability group 5.

SaC—Sarben loamy fine sand, 3 to 6 percent slopes. This very deep, gently sloping, well drained soil is on uplands. It formed in sandy and loamy eolian material. Areas range from 5 acres to more than 100 acres in size.

Typically, the surface layer is brown, friable loamy fine sand about 6 inches thick. Next is a transitional layer of brown loamy very fine sand about 6 inches thick. The underlying material to a depth of 60 inches or more is very pale brown loamy very fine sand. Carbonates are at a depth of about 35 inches. In some areas the dark surface layer is more than 10 inches thick. In other areas the underlying material is loamy fine sand or loamy sand.

Included with this soil in mapping are small areas of Satanta and Vetal soils. Satanta soils have a mollic epipedon. They have more clay in the control section than the Sarben soil. They are in landscape positions lower than those of the Sarben soil. Vetal soils have a mollic epipedon more than 20 inches thick. They are in swales below the Sarben soil. Included soils make up less than 10 percent of the map unit.

Permeability is moderately rapid in the Sarben soil, and the available water capacity is high. Runoff is medium. The organic matter content is low. The water intake rate is high.

Most of the acreage of this soil is used for cultivated crops. Some areas are irrigated if water is available. A few areas are used as pasture or range.

If dry-farmed, this soil is poorly suited to corn and winter wheat and to grasses and legumes for hay and pasture. Soil blowing is a severe hazard. Water erosion also is a hazard. The low fertility is a limitation. A system of conservation tillage, such as summer fallowing or disking, helps to conserve moisture and control soil blowing and water erosion. Incorporating crop residue into the plow layer helps to improve and maintain organic matter content, fertility, and tilth. Applications of fertilizer also improve fertility.

If irrigated by sprinklers, this soil is suited to corn, alfalfa, winter wheat, and introduced grasses. Soil blowing is a severe hazard. It can be controlled by leaving crop residue on the surface. Incorporating crop residue into the plow layer helps to improve and maintain organic matter content, fertility, and tilth. This soil is unsuited to gravity irrigation because of the high water intake rate and the undulating topography.

This soil is suited to range. A cover of range plants is effective in controlling soil blowing. Overgrazing or improper haying methods reduce the amount of protective cover and the quality of native plants. As a result, water erosion and soil blowing are excessive and small blowouts can form. Proper grazing use, timely deferment of grazing and haying, and a planned grazing system help to keep the native plants in good condition. Range seeding may be needed to stabilize severely eroded areas of cropland.

This soil is suited to the trees and shrubs grown as windbreaks and to plantings that enhance recreational areas and wildlife habitat. The survival and growth rates of adapted species are fair. The lack of seasonal rainfall and soil blowing are hazards. Soil blowing can be controlled by maintaining strips of sod or cover crops between the tree rows. Irrigation can provide the moisture needed during dry periods. Hoeing by hand, rototilling, and applying the appropriate herbicide help to control plant competition in the tree rows.

This soil generally is suited to septic tank absorption fields, dwellings, and roads. The sides of shallow excavations can cave in unless they are shored.

The capability units are IVe-5, dryland, and IVe-10, irrigated; Sandy range site; windbreak suitability group 5.

SaD—Sarben loamy fine sand, 6 to 9 percent slopes. This very deep, strongly sloping, well drained soil is on rolling uplands. It formed in sandy and loamy eolian material. Areas range from 5 to more than 100 acres in size.

Typically, the surface layer is grayish brown, very friable loamy fine sand about 5 inches thick. Next is a transitional layer of brown, very friable very fine sandy loam about 6 inches thick. The underlying material extends to a depth of 60 inches or more. It is pale brown very fine sandy loam in the upper part and calcareous loamy very fine sand in the lower part. In some areas the dark color of the surface soil extends to a depth of more than 10 inches. In other areas the underlying material is loamy fine sand or loamy sand.

Included with this soil in mapping are small areas of Valent and Vetal soils. Valent soils have more sand in the control section than the Sarben soil. They are on hummocks and dunes. Vetal soils have a mollic epipedon more than 20 inches thick. They are in swales below the Sarben soil. Included soils make up less than 10 percent of the map unit.

Permeability is moderately rapid in the Sarben soil, and the available water capacity is high. Runoff is medium. The organic matter content is low. The water intake rate is high.

More than half of the acreage of this soil is used as pasture and range. The rest is used as cropland. Some areas of cropland are irrigated with center-pivot irrigation systems.

If dry-farmed, this soil is poorly suited to corn and winter wheat and to grasses and legumes for hay and pasture. Soil blowing is a severe hazard. Water erosion also is a hazard. The low fertility is a limitation. A system of conservation tillage, such as summer fallowing or disking, helps to conserve moisture and control soil blowing and water erosion. Incorporating crop residue into the plow layer helps to improve and maintain organic matter content, fertility, and tilth. Applications of fertilizers also improve fertility.

This soil is poorly suited to sprinkler irrigation because of the severe hazards of soil blowing and water erosion. The low fertility is a limitation. A system of conservation tillage, such as disking, that leaves crop residue on the soil helps to control soil blowing and water erosion and improve and maintain organic matter content and fertility. Applications of fertilizer also improve fertility.

If this soil is used as range or hayland, the climax vegetation is prairie sandreed, sand bluestem, needleandthread, little bluestem, and blue grama. These species make up 75 percent or more of the total annual forage. Sand sagebrush, western wheatgrass, sedges, and forbs make up the rest. If subject to continuous heavy grazing, sand bluestem and little bluestem decrease in abundance and are replaced by needleandthread, prairie sandreed, blue grama, Scribner panicum, and forbs. If overgrazing continues for many years the native plants lose vigor and are unable to stabilize the site. As a result, water erosion and soil blowing are excessive.

If the range is in excellent condition, the suggested initial stocking rate is 0.7 animal unit month per acre. A

planned grazing system that includes proper grazing use and timely deferment of grazing and haying helps to maintain or improve the range condition. This soil generally is the first to be overgrazed when it is in a pasture that includes Sands or Choppy Sands range sites. Properly located fences and livestock watering and salting facilities can result in a more uniform distribution of grazing. Areas previously used as cropland should be reseeded to a suitable grass mixture if they are used as range.

If this soil is used as hayland, mowing should be regulated so that the grasses remain healthy and vigorous. The forage should be harvested for hay only every other year. During the year the forage is not harvested, the hayland should be used as fall or winter range.

This soil is suited to the trees and shrubs grown as windbreaks and to plantings that enhance recreational areas and wildlife habitat. The survival and growth rates of adapted species are fair. The lack of seasonal rainfall and soil blowing are hazards. Soil blowing can be controlled by maintaining strips of sod or cover crops between the tree rows. Irrigation can provide the moisture needed during dry periods. Hoeing by hand, rototilling, and applying the appropriate herbicide help to control plant competition in the tree rows.

This soil generally is suited to septic tank absorption fields, dwellings, and roads. The sides of shallow excavations can cave in unless they are shored.

The capability units are VIe-5, dryland, and IVe-10, irrigated; Sandy range site; windbreak suitability group 5.

SaE—Sarben loamy fine sand, 9 to 20 percent slopes. This very deep, moderately steep, well drained soil is on uplands. It formed in sandy and loamy eolian material. Areas are irregular in shape and range from 5 to 300 acres in size.

Typically, the surface layer is brown, very friable loamy fine sand about 8 inches thick. Next is a transitional layer of brown, very friable loamy very fine sand about 13 inches thick. The underlying material extends to a depth of more than 60 inches. It is pale brown, loose loamy very fine sand in the upper part and very pale brown, calcareous loamy very fine sand in the lower part. In some areas the dark color of the surface layer is more than 10 inches thick.

Included with this soil in mapping are small areas of Valent soils. Valent soils have more sand in the control section than the Sarben soil. They are on hummocks and dunes. They make up less than 10 percent of the map unit.

Permeability is moderately rapid in the Sarben soil, and the available water capacity is high. Runoff is rapid. The organic matter content is low.

All of the acreage of this soil is used as range. This soil is unsuited to cropland because of soil blowing and the moderate available water capacity. Slope is the main limitation affecting center-pivot irrigation systems.

If this soil is used as range or hayland, the climax vegetation is prairie sandreed, sand bluestem, needleandthread, little bluestem, and blue grama. These species make up 75 percent or more of the total annual forage. Sand sagebrush, western wheatgrass, and forbs make up the rest. If subject to continuous heavy grazing, sand bluestem and little bluestem decrease in abundance and are replaced by needleandthread, prairie sandreed, blue grama, Scribner panicum, and forbs. If overgrazing continues for many years, the native plants lose vigor and are unable to stabilize the site. As a result, water erosion and soil blowing are excessive.

If the range is in excellent condition, the suggested initial stocking rate is 0.7 animal unit month per acre. A planned grazing system that includes proper grazing use and timely deferment of grazing and haying helps to maintain or improve the range condition. This soil generally is the first to be overgrazed when it is in a pasture that includes Sands or Choppy Sands range sites. Properly located fences and livestock watering and salting facilities can result in a more uniform distribution of grazing. Areas previously used as cropland should be reseeded to a suitable grass mixture if they are used as range.

If this soil is used as hayland, mowing should be regulated so that the grasses remain healthy and vigorous. The forage should be harvested for hay only every other year. During the year the forage is not harvested, the hayland should be used as fall or winter range.

This soil is suited to the trees and shrubs grown as windbreaks and to plantings that enhance recreational areas and wildlife habitat. The survival and growth rates of adapted species are fair. Soil blowing, the loose soil on the surface, and the lack of seasonal rainfall are hazards. Young seedlings can be damaged by windblown sand. Soil blowing can be controlled by maintaining strips of sod or cover crops between the tree rows. The trees need to be planted in shallow furrows with as little disturbance of the soil as possible. Irrigation can provide the moisture needed for establishing seedlings during dry periods. Hoeing by hand or rototilling help to control plant competition in the tree roes.

Land shaping and installing the distribution lines on the contour in areas of this soil help to ensure that septic tank absorption fields function properly. This soil generally is not suited to sanitary facilities in areas

where the slope is more than 15 percent. A suitable alternative site should be selected. Dwellings should be designed so that they conform to the natural slope of the land, or building sites should be graded to a suitable gradient. The sides of shallow excavations can cave in unless they are shored. Cutting and filling can provide a suitable grade for roads.

The capability unit is VIe-5, dryland; Sandy range site; windbreak suitability group 7.

Sb—Satanta loam, 0 to 1 percent slopes. This very deep, nearly level, well drained soil is on uplands. It formed in loamy eolian material. Areas are irregular in shape and range from 5 to 80 acres in size.

Typically, the surface layer is grayish brown, friable loam about 6 inches thick. The subsoil is about 28 inches thick. The upper part is grayish brown, firm clay loam, the next part is dark grayish brown, firm clay loam, and the lower part is pale brown and light gray, calcareous, friable loam. The underlying material to a depth of more than 60 inches is light gray very fine sandy loam and very pale brown fine sandy loam. In a few areas the surface layer is lighter in color.

Included with this soil in mapping are small areas of Altvan, Kuma, and Lodgepole soils. Altvan soils have gravelly coarse sand at a depth of 20 to 40 inches. They are on the steeper slopes. Kuma soils have less sand in the control section than the Satanta soil. They have a mollic epipedon more than 20 inches thick. They are in landscape positions slightly lower than those of the Satanta soil. Lodgepole soils have more clay in the subsoil than the Satanta soil. They are in somewhat poorly drained depressions. Included soils make up less than 10 percent of the map unit.

Permeability is moderate in the Satanta soil, and the available water capacity is high. Runoff is slow. The organic matter content is moderately low. The water intake rate also is moderately low.

Most of the acreage of this soil is used for cultivated crops. Some areas are irrigated if water is available. A few areas are used as pasture or range.

If dry-farmed, this soil is suited to winter wheat and to grasses and legumes for hay and pasture. Soil blowing is a slight hazard in areas where the surface is not adequately protected by crops or crop residue. A system of conservation tillage, such as disking or chiseling, that leaves crop residue on the surface helps to control soil blowing and conserve moisture. Summer fallowing can help to increase the moisture supply needed for winter wheat. Returning crop residue to the soil helps to improve and maintain organic matter content, fertility, and tilth and increases the rate of water infiltration.

If irrigated, this soil is suited to corn, alfalfa, and beans. Soil blowing is a slight hazard. A system of conservation tillage, such as disking or chiseling, that leaves crop residue on the surface helps to control soil blowing. Water can be applied by sprinkler irrigation systems. Gravity irrigation systems also are suitable if areas are leveled or if a suitable grade is established so that excessive water erosion can be controlled.

This soil is suited to range. A cover of range plants is effective in controlling soil blowing. Overgrazing or improper haying methods reduce the amount of protective cover and the quality of native plants. Overgrazing also can result in the hazards of water erosion and soil blowing. Proper grazing use, timely deferment of grazing, and a planned grazing system help to keep the native plants in good condition.

This soil is suited to the trees and shrubs grown as windbreaks and to plantings that enhance recreational areas and wildlife habitat. The survival and growth rates of adapted species are good. Drought and weeds and grasses that compete with the trees for moisture are the main limitations. The weeds and undesirable grasses can be controlled by good site preparation, timely cultivation between the tree rows, or by applications of the appropriate herbicide. Irrigation can provide the moisture needed during dry periods.

The moderate permeability is a limitation on sites for septic tank absorption fields. It generally can be overcome by increasing the size of the field. This soil generally is suited to dwellings. The sides of shallow excavations can cave in unless they are shored. The damage to roads caused by frost action can be minimized by a good surface drainage system. Crowning the road by grading and constructing adequate roadside ditches helps to provide the needed surface drainage.

The capability units are IIc-1, dryland, and I-4, irrigated; Silty range site; windbreak suitability group 3.

SbB—Satanta loam, 1 to 3 percent slopes. This deep, very gently sloping, well drained soil is on uplands. It formed in loamy eolian material. Areas are irregular in shape and range from 5 to 200 acres in size.

Typically, the surface layer is grayish brown, friable loam about 6 inches thick. The subsoil is about 28 inches thick. The upper part is dark grayish brown, friable loam, the next part is brown, friable loam, and the lower part is light gray, calcareous, friable loam. The underlying material to a depth of more than 60 inches is pale brown and very pale brown loam. In a few places the surface layer is lighter in color. In other places the underlying material is loamy sand, sandy loam, or loamy fine sand below a depth of 40 inches.

Included with this soil in mapping are small areas of

Altvan, Kuma, and Lodgepole soils. Altvan soils have gravelly coarse sand at a depth of 20 to 40 inches. They are on the steeper slopes. Kuma soils have less sand in the control section than the Satanta soil. They have a mollic epipedon more than 20 inches thick. They are in landscape positions slightly lower than those of the Satanta soil. Lodgepole soils have more clay in the subsoil than the Satanta soil. They are in somewhat poorly drained depressions. Included soils make up less than 10 percent of the map unit.

Permeability is moderate in the Satanta soil, and the available water capacity is high. Runoff is slow or medium. The organic matter content is moderate. The water intake rate is moderately low.

Most of the acreage of this soil is used for cultivated crops. Some areas are irrigated if water is available. A few areas are used as pasture or range.

If dry-farmed, this soil is suited to winter wheat and grain sorghum and to grasses and legumes for hay and pasture. Water erosion and soil blowing are hazards in areas where the surface is not adequately protected by crops or crop residue. A system of conservation tillage, such as disking or chiseling, that leaves crop residue on the surface helps to control soil blowing and water erosion and conserve moisture. Terraces minimize the amount of water lost during periods of heavy rainfall and help to keep moisture on the fields for crops. Summer fallowing can help to increase the moisture supply needed for winter wheat. Returning crop residue to the soil helps to improve and maintain organic matter content, fertility, and tilth and increases the rate of water infiltration.

If irrigated, this soil is suited to corn, alfalfa, and grain sorghum. Soil blowing and water erosion are the principal hazards. A system of conservation tillage, such as disking or chiseling, that leaves crop residue on the surface helps to control soil blowing and water erosion. Terraces minimize the amount of water lost during periods of heavy rainfall. Water can be applied by sprinkler irrigation systems. Gravity irrigation systems also are suitable if areas are leveled or if a suitable grade is established so that water erosion can be controlled.

This soil is suited to range. A cover of range plants is effective in controlling soil blowing. Overgrazing or improper haying methods reduce the amount of protective cover and the quality of native plants. Overgrazing also can result in the hazards of water erosion and soil blowing. Proper grazing use, timely deferment of grazing, and a planned grazing system help to keep the native plants in good condition.

This soil is suited to the trees and shrubs grown as windbreaks and to plantings that enhance recreational areas and wildlife habitat. The survival and growth rates of adapted species are good. Drought and weeds and grasses that compete with the trees for moisture are the main limitations. The weeds and undesirable grasses can be controlled by good site preparation, timely cultivation between the tree rows, or by applications of the appropriate herbicide. Irrigation can provide the moisture needed during dry periods.

This soil generally is suited to septic tank absorption fields and dwellings. The damage to roads caused by frost action can be minimized by a good surface drainage system. Crowning the road by grading and constructing adequate roadside ditches helps to provide the needed surface drainage.

The capability units are IIe-1, dryland, and IIe-4, irrigated; Silty range site; windbreak suitability group 3.

SbC—Satanta loam, 3 to 6 percent slopes. This deep, gently sloping, well drained soil is on uplands. It formed in loamy eolian material. Areas are irregular in shape and range from 5 to 100 acres in size.

Typically, the surface layer is brown, friable loam about 6 inches thick. The subsoil is about 21 inches thick. The upper part is brown, friable clay loam, the next part is pale brown, friable loam, and the lower part is very pale brown, calcareous, friable loam. The underlying material to a depth of more than 60 inches is very pale brown, calcareous loam. In a few places the surface layer is lighter in color. In other places the underlying material is loamy sand, sandy loam, or loamy fine sand below a depth of 40 inches.

Included with this soil in mapping are small areas of Altvan, Kuma, and Lodgepole soils. Altvan soils have gravelly coarse sand at a depth of 20 to 40 inches. They are on the steeper slopes. Kuma soils have less sand in the control section than the Satanta soil. They have a mollic epipedon more than 20 inches thick. They are in landscape positions slightly lower than those of the Satanta soil. Lodgepole soils have more clay in the subsoil than the Satanta soil. They are in somewhat poorly drained depressions. Included soils make up less than 10 percent of the map unit.

Permeability is moderate in the Satanta soil, and the available water capacity is high. Runoff is medium. The organic matter content is moderate. The water intake rate is moderately low.

Most of the acreage of this soil is used for cultivated crops. Some areas are irrigated if water is available. A few areas are used as pasture or range.

If dry-farmed, this soil is suited to winter wheat and grain sorghum and to grasses and legumes for hay and pasture. Water erosion and soil blowing are hazards in areas where the surface is not adequately protected by crops or crop residue. A system of conservation tillage, such as disking or chiseling, that leaves crop residue on

the surface helps to control soil blowing and water erosion and conserve moisture. Terraces minimize the amount of water lost during heavy rainfall and help to keep moisture on the fields for crops. Summer fallowing can help increase the moisture supply needed for winter wheat. Returning crop residue to the soil helps to improve and maintain organic matter content, fertility, and tilth and increases the rate of water infiltration.

If irrigated, this soil is suited to corn, alfalfa, and grain sorghum. Soil blowing and water erosion are the principal hazards. A system of conservation tillage, such as disking or chiseling, that leaves crop residue on the surface helps to control soil blowing and water erosion. Terraces minimize the amount of water lost during heavy rainfall. Water can be applied by sprinkler irrigation systems. Gravity systems also are suitable if areas are leveled or if a suitable grade is established so that water erosion can be controlled.

This soil is suited to range. A cover of range plants is effective in controlling soil blowing. Overgrazing or improper haying methods reduce the amount of protective cover and the quality of native plants. Overgrazing also can result in the hazards of water erosion and soil blowing. Proper grazing use, timely deferment of grazing, and a planned grazing system help to keep the native plants in good condition.

This soil is suited to the trees and shrubs grown as windbreaks and to plantings that enhance recreational areas and wildlife habitat. The survival and growth rates of adapted species are good. Drought and weeds and grasses that compete with the trees for moisture are the main limitations. The weeds and undesirable grasses can be controlled by good site preparation, timely cultivation between the tree rows, or by applications of the appropriate herbicide. Irrigation can provide the moisture needed during dry periods.

This soil generally is suited to septic tank absorption fields and dwellings. The damage to roads caused by frost action can be minimized by a good surface drainage system. Crowning the road by grading and constructing adequate roadside ditches helps to provide the needed surface drainage.

The capability units are IIIe-1, dryland, and IIIe-4, irrigated; Silty range site; windbreak suitability group 3.

ScD—Satanta-Dix complex, 3 to 9 percent slopes. These very deep, well drained and excessively drained, gently sloping and strongly sloping soils are on uplands. The well drained Satanta soil formed in loamy eolian material. It does not have coarse material above a depth of 60 inches. The excessively drained Dix soil formed in 4 to 10 inches of loamy and sandy material over gravelly coarse sand. The Satanta soil is in areas of linear or concave side slopes. The Dix soil is on narrow ridgetops and convex shoulder slopes. Areas range from 10 to 100 acres in size. They are about 55 to 75 percent Satanta soil and 20 to 40 percent Dix soil. These two soils occur as areas so intricately mixed or so small in size that separating them in mapping is not practical.

Typically, the Satanta soil has a surface soil of grayish brown, friable loam about 6 inches thick. The subsoil is about 23 inches thick. The upper part is grayish brown, friable loam, the next part is pale brown, friable loam, and the lower part is very pale brown, calcareous loam. The underlying material extends to a depth of more than 60 inches. It is very pale brown, calcareous loam in the upper part and very pale brown, calcareous fine sandy loam in the lower part. In some places the underlying material is loamy sand, sandy loam, or loamy fine sand below a depth of 40 inches.

Typically, the Dix soil has a surface soil of light yellowish brown, very friable gravelly loam about 6 inches thick. The underlying material is very pale brown, loose gravelly coarse sand. In some areas the underlying material is calcareous.

Included with these soils in mapping are Altvan and Rosebud soils and areas of rock outcrop. Altvan soils have gravelly coarse sand at a depth of 20 to 40 inches. They are in landscape positions similar to those of the Satanta and Dix soils. Rosebud soils are moderately deep to soft limestone. They are in landscape positions lower than those of the Satanta and Dix soils. The areas of rock outcrop are on ledges that are below the Satanta and Dix soils. Inclusions make up 5 to 15 percent of the map unit.

Permeability is moderate in the Satanta soil. It is very rapid in the underlying material of the Dix soil. The available water capacity is high in the Satanta soil and very low in the Dix soil. Runoff is medium or rapid on both soils. The organic matter content is moderately low. The water intake rate is moderately low in the Satanta soil and very high in the Dix soil.

Most of the acreage of these soils is used for cropland. Winter wheat is the principal dryland crop. These soils are poorly suited as cropland because of the slope and droughtiness.

If dry-farmed, these soils are poorly suited to wheat and to grasses and legumes for hay and pasture. Soil blowing and water erosion are the principal hazards. A system of conservation tillage, such as stubble mulching, disking, or chiseling, that leaves crop residue on the surface helps to control soil blowing and water erosion and conserves moisture. Terraces help to control water erosion during periods of heavy rainfall and help to keep moisture on the fields for crops. Summer fallowing can help to increase the moisture supply needed for winter wheat. Returning crop residue

to the soil helps to improve and maintain organic matter content, fertility, and tilth and increases the rate of water infiltration.

If irrigated, these soils are poorly suited to corn, beans, and alfalfa. Soil blowing and water erosion are the principal hazards. A system of conservation tillage, such as disking or chiseling, that leaves crop residue on the surface helps to control soil blowing and water erosion. Terraces help to control water erosion during periods of heavy rainfall. Gravity irrigation systems are unsuited to this soil. Sprinkler irrigation systems are best suited to the gently sloping to strongly sloping areas.

These soils are suited to range. A cover of range plants is effective in controlling soil blowing and water erosion. Overgrazing or improper haying methods reduce the amount of protective cover and the quality of native plants. Overgrazing also can result in the hazards of water erosion and soil blowing. Proper grazing use, timely deferment of grazing and haying, and a planned grazing system help to keep the native plants in good condition. Range seeding may be needed to stabilize severely eroded areas of cropland.

The Satanta soil is suited to the trees and shrubs grown as windbreaks and to plantings that enhance recreational areas and wildlife habitat. The survival and growth rates of adapted species are good. Some areas are suitable sites for windbreaks; however, onsite investigation is needed. Weeds and undesirable grasses that compete with the trees for moisture, a lack of seasonal rainfall, and water erosion are limitations. Hoeing by hand, rototilling, and applying the appropriate herbicide help to control weeds in the tree rows. Irrigation can provide the moisture needed during periods of low rainfall. Planting the trees on the contour and terracing reduce the runoff rate and help to control water erosion.

The moderate permeability is a limitation if the Satanta soil is used as a site for septic tank absorption fields. It generally can be overcome by increasing the size of the field. The Satanta soil generally is suited to dwellings. The Dix soil readily absorbs but does not adequately filter the effluent in septic tank absorption fields. The poor filtering capacity can result in pollution of underground water supplies. The sides of shallow excavations in both soils can cave in unless they are shored. The damage to roads caused by frost action can be minimized by a good surface drainage system. Crowning the road by grading and constructing adequate roadside ditches help to provide the needed surface drainage.

The capability units are IVe-1, dryland, and IVe-4, irrigated. The Satanta soil is in the Silty range site, and the Dix soil is in the Shallow to Gravel range site. The Satanta soil is in windbreak suitability group 3, and the Dix soil is in windbreak suitability group 10.

SfD—Sully loam, 6 to 9 percent slopes. This very deep, well drained, strongly sloping soil is on convex breaks between the smooth upland divides and the steep canyons. It formed in loess. Areas are irregular in shape and range from 5 to 80 acres in size.

Typically, the surface layer is brown, friable, calcareous loam about 5 inches thick. Next is a transitional layer of very pale brown, friable, calcareous silt loam about 4 inches thick. The underlying material to a depth of more than 60 inches is light gray, calcareous silt loam. A few small areas may have dark colluvial soils at the base of drainageways.

Included with this soil in mapping are Keith and McConaughy soils. These soils have a mollic epipedon. Keith soils have more clay in the control section than the Sully soil. They are on summits above the Sully soil. McConaughy soils are on lower back slopes below the Sully soil. Included soils make up less than 10 percent of the map unit.

Permeability is moderate in the Sully soil, and the available water capacity is high. Runoff is medium. The organic matter content is low. The water intake rate is moderate. The soil is often deficient in the amount of nitrogen, phosphorus, and trace elements.

Most of the acreage of this soil is used for dryland crops. A few areas are used as range.

If dry-farmed, this soil is poorly suited to wheat and to grasses and alfalfa for hay and pasture. Water erosion and soil blowing are hazards in areas where the surface is not adequately protected by crops or crop residue. A system of conservation tillage, such as terraces, chiseling, disking, or contour farming, can help to control water erosion and soil blowing and to keep moisture on the fields. Summer fallowing is needed to increase the moisture content in the subsoil.

This soil is poorly suited to irrigated crops because of the severe hazard of erosion. A system of conservation tillage, such as terraces, chiseling, or contour farming, can help to control water erosion and to keep moisture on the fields.

This soil is suited to range. A cover of range plants is effective in controlling soil blowing and water erosion. Overgrazing or improper haying methods reduce the amount of protective cover and the quality of native plants. Overgrazing also can result in the hazards of water erosion and soil blowing. Proper grazing use, timely deferment of grazing, and a planned grazing system help to keep the native plants in good condition. Range seeding may be needed to stabilize severely eroded areas of cropland.

This soil is suited to the trees and shrubs grown as

windbreaks and to plantings that enhance recreational areas and wildlife habitat. The survival and growth rates of adapted species are fair. Weeds and undesirable grasses that compete with the trees for moisture, a lack of seasonal rainfall, and water erosion are limitations. Hoeing by hand, rototilling, and applying the appropriate herbicide help to control weeds in the tree rows. Irrigation can provide the moisture needed during periods of low rainfall. Planting the trees on the contour and terracing reduce the runoff rate and help to control water erosion. The high content of calcium in this soil is a limitation. Only the trees and shrubs that can tolerate an excessive amount of calcium carbonate should be selected for planting.

The moderate permeability is a limitation on sites for septic tank absorption fields. It generally can be overcome by increasing the size of the field. This soil generally is suited to dwellings. Roads built on this soil need to be designed so that the surface pavement and base material are thick enough to compensate for the low strength of the soil. Coarser grained base material can be used to ensure better performance.

The capability units are IVe-9, dryland, and IVe-6, irrigated; Limy Upland range site; windbreak suitability group 8.

SfG—Sully loam, 30 to 60 percent slopes. This very deep, well drained, very steep soil is in deep canyons that dissect the upland divides (fig. 11). It formed in loess. Many places have catsteps, or short, vertical exposures of undeveloped loess. Larger vertical escarpments are near the base of the canyon sides. Areas range from 50 to several hundred acres in size.

Typically, the surface layer is brown, friable, calcareous loam about 4 inches thick. Next is a transitional layer of brown, calcareous silt loam about 3 inches thick. The underlying material to a depth of more than 60 inches is pale brown, calcareous silt loam. In some areas the underlying material has been exposed at the surface.

Included with this soil in mapping are Dix, McConaughy, and Tassel soils and areas of rock outcrop. Dix soils have very gravelly coarse sand above a depth of 10 inches. They are in landscape positions lower than those of the Sully soil. McConaughy soils have a mollic epipedon. They are in the less sloping areas. Tassel soils are loamy and are shallow to calcareous sandstone bedrock. Tassel soils and the areas of rock outcrop are on the lower side slopes. Inclusions make up 5 to 15 percent of the map unit.

Permeability is moderate in the Sully soil, and the available water capacity is high. Runoff is rapid. The organic matter content is moderately low.

All of the acreage of this soil supports native grasses and is used as range. This soil is unsuitable as cropland because of the slope.

If this soil is used as range, the climax vegetation is dominantly little bluestem, western wheatgrass, blue grama, and sideoats grama. These species make up 55 percent or more of the total annual forage. Needleandthread, plains muhly, sedges, and forbs make up the rest. If subject to continuous heavy grazing, little bluestem, sideoats grama, and western wheatgrass decrease in abundance and are replaced by blue grama, plains muhly, needleandthread, numerous annual grasses, and forbs. If overgrazing continues for many years, the plants lose vigor and are unable to stabilize the site. As a result, water erosion is excessive.

If the range is in excellent condition, the suggested initial stocking rate is 0.4 animal unit month per acre. A planned grazing system that includes proper grazing use and timely deferment of grazing helps to maintain or improve the range condition. Properly located fences and livestock watering and salting facilities can result in a more uniform distribution of grazing. Because of the slope, it is difficult for livestock to graze in areas of this soil.

This soil generally is unsuited to the trees and shrubs grown as windbreaks. The slope prevents the use of conventional tree-planting and tillage equipment. Some small areas are suitable sites for planting trees; however, onsite investigation is needed.

This soil generally is not suited to sanitary facilities because of the slope. A suitable alternative site should be selected. Dwellings should be designed so that they conform to the natural slope of the land, or building sites should be graded to a suitable gradient. Cutting and filling can provide a suitable grade for roads. Roads built on this soil need to be designed so that the surface pavement and base material are thick enough to compensate for the low strength of the soil. Coarser grained base material can be used to ensure better performance.

The capability unit is VIIe-9, dryland; Thin Loess range site; windbreak suitability group 10.

SkE—Sully-Dix complex, 9 to 20 percent slopes. These very deep, well drained and excessively drained, moderately steep and steep soils are on uplands. The well drained Sully soil formed in loess. It does not have coarse material above a depth of 60 inches. The excessively drained Dix soil formed in 4 to 10 inches of loamy and sandy material over gravelly coarse sand. The Sully soil is on side slopes that are in plane or slightly concave positions on the landscape. The Dix soils are on narrow ridgetops and convex slopes. Areas range from 20 to 150 acres in size. They are 65 to 85

Figure 11.—An area of Sully loam, 30 to 60 percent slopes, used primarily as range because of the slope.

percent Sully soil and 15 to 35 percent Dix soil. These two soils occur as areas so intricately mixed or so small in size that separating them in mapping is not practical.

Typically, the Sully soil has a surface layer of brown, calcareous loam about 3 inches thick. The underlying material to a depth of more than 60 inches is pale brown and very pale brown, calcareous silt loam. Some places have a transitional layer.

Typically, the Dix soil has a surface soil of brown, very friable gravelly loam about 4 inches thick. The underlying material is light yellowish brown, loose, very gravelly coarse sand. In some areas the underlying material is calcareous.

Included with these soils in mapping are Duroc and McConaughy soils. Duroc and McConaughy soils have more clay in the control section than the Sully and Dix soils. Duroc soils have a mollic epipedon more than 20 inches thick. They are on toe slopes below the Sully and Dix soils. McConaughy soils have a mollic epipedon. They are on lower back slopes below the Sully and Dix soils. Included soils make up 5 to 15 percent of the map unit.

Permeability is moderate in the Sully soil. It is very rapid in the underlying material of the Dix soil. The available water capacity is high in the Sully soil and very low in the Dix soil. Runoff is medium or rapid in both soils. The organic matter content is moderately low.

Most of the acreage of these soils supports native grasses and is used as range. These soils are not suited to cultivated crops because of droughtiness and the slope. Range seeding may be needed in severely eroded areas that were previously used as cropland.

If these soils are used as range or hayland, the climax vegetation is dominantly little bluestem, sand bluestem, sideoats grama, and blue grama. These species make up 70 percent or more of the total annual forage. Plains muhly, needleandthread, western

wheatgrass, and forbs make up the rest. If subject to continuous heavy grazing, sand bluestem and little bluestem decrease in abundance and are replaced by hairy grama, western wheatgrass, needleandthread, plains muhly, sedges, and forbs. If overgrazing continues for many years, the native grasses lose vigor and are unable to stabilize the site. As a result, water erosion is excessive.

If the range is in excellent condition, the suggested initial stocking rate is 0.6 animal unit month per acre on the Sully soil and 0.4 animal unit month per acre on the Dix soil. A planned grazing system that includes proper grazing use and timely deferment of grazing and haying helps to maintain or improve the range condition. Properly located fences and livestock watering and salting facilities can result in a more uniform distribution of grazing. Areas previously used as cropland should be reseeded to a suitable grass mixture if they are used as range. In areas where gullies have formed because of severe water erosion, land shaping or other mechanical practices may be needed to smooth and stabilize the site before it is reseeded.

The Sully soil is suited to the trees and shrubs grown as windbreaks and to plantings that enhance recreational areas and wildlife habitat. The Dix soil is unsuited to these uses. The survival and growth rates of adapted species are fair. Some areas are suitable sites for windbreaks; however, onsite investigation is needed. Weeds and undesirable grasses that compete with the trees for moisture, a lack of seasonal rainfall, and water erosion are limitations. Hoeing by hand, rototilling, and applying the appropriate herbicide help to control weeds in the tree rows. Irrigation can provide the moisture needed during periods of low rainfall. Planting the trees on the contour and terracing reduce the runoff rate and help to control water erosion. The high content of calcium in the Sully soil is a limitation. Only the trees and shrubs that can tolerate an excessive amount of calcium carbonate should be selected for planting.

Land shaping and installing the distribution lines on the contour in areas of the Sully soil help to ensure that septic tank absorption fields function properly. The moderate permeability is a limitation on sites for septic tank absorption fields. It generally can be overcome by increasing the size of the field. The Dix soil readily absorbs but does not adequately filter the effluent in septic tank absorption fields. The poor filtering capacity can result in pollution of underground water supplies. The sides of shallow excavations in the Dix soil can cave in unless they are shored. Dwellings should be designed so that they conform to the natural slope of the land, or building sites should be graded to a suitable gradient. Cutting and filling can provide a suitable grade for roads. Roads constructed in areas of the Sully soil need to be designed so that the surface pavement and base material are thick enough to compensate for the low strength of the soil. Coarser grained base material can be used to ensure better performance.

The capability unit is VIe-9, dryland. The Sully soil is in windbreak suitability group 8, and the Dix soil in windbreak suitability group 10. The Sully soil is in the Limy Upland range site, and the Dix soil is in the Shallow to Gravel range site.

SmE2—Sully-McConaughy complex, 9 to 20 percent slopes, eroded. These very deep, well drained, moderately steep and steep soils are on deeply dissected uplands. They formed in loess. Because of water erosion, the surface is generally rilled. The Sully soil is on moderately steep, convex slopes. The McConaughy soil is on linear or concave lower back slopes that have a slope of less than 15 percent. Areas range from 10 to 100 acres in size. They are 50 to 80 percent Sully soil and 15 to 40 percent McConaughy soil. These two soils occur as areas so intricately mixed or so small in size that separating them in mapping is not practical.

Typically, the Sully soil has a surface layer of pale brown, calcareous friable loam about 6 inches thick. The underlying material to a depth of more than 60 inches is light gray and very pale brown, calcareous silt loam. In some areas the surface layer is less than 3 inches thick. In other areas the underlying material has been exposed at the surface.

Typically, the McConaughy soil has a surface soil of grayish brown, friable loam about 13 inches thick. The subsoil is pale brown, friable loam about 4 inches thick. The underlying material to a depth of more than 60 inches is very pale brown, calcareous silt loam. In some areas the surface layer is calcareous.

Included with these soils in mapping are Duroc and Keith soils. Duroc soils have a mollic epipedon more than 20 inches thick. They are on toe slopes below the Sully and McConaughy soils and in intermittent drainageways. Keith soils have more clay in the control section than the Sully and McConaughy soils. They have a subsoil that is better developed than that of the Sully and McConaughy soils. They are on less sloping summits above the Sully and McConaughy soils. Included soils make up 5 to 15 percent of the map unit.

Permeability is moderate in the Sully and McConaughy soils. The available water capacity is high. Runoff is medium or rapid. The organic matter content is low in the Sully soil and moderately low in the McConaughy soil. The Sully soil is often deficient in the amount of nitrogen, phosphorus, and trace elements.

Most of the acreage of these soils is used for dryland

crops. A few areas have been reseeded to native grasses.

These soils generally are unsuited to cropland because of the slope and the severe hazard of water erosion. These areas should be reseeded to native grasses to reduce soil losses caused by water erosion.

These soils are unsuited to irrigated crops because of the slope and the severe hazard of water erosion.

These soils are suited to range. A cover of range plants is effective in controlling soil blowing and water erosion. Overgrazing or improper haying methods reduce the amount of protective cover and the quality of native plants. Overgrazing also can result in the hazards of water erosion and soil blowing. Proper grazing use, timely deferment of grazing and haying, and a planned grazing system help to keep the native plants in good condition. Range seeding may be needed to stabilize severely eroded areas of cropland.

These soils are suited to the trees and shrubs grown as windbreaks and to plantings that enhance recreational areas and wildlife habitat. The survival and growth rates of adapted species are fair. Weeds and undesirable grasses that compete with the trees for moisture, a lack of seasonal rainfall, and water erosion are limitations. Hoeing by hand, rototilling, and applying the appropriate herbicide help to control weeds in the tree rows. Irrigation can provide the moisture needed during periods of low rainfall. Planting the trees on the contour and terracing reduce the runoff rate and help to control water erosion. The high content of calcium in the Sully soil is a limitation. Only the trees and shrubs that can tolerate an excessive amount of calcium carbonate should be selected for planting.

Land shaping and installing the distribution lines on the contour in areas of these soils help to ensure that septic tank absorption fields function properly. The moderate permeability is a limitation if these soils are used as a site for septic tank absorption fields. It generally can be overcome by increasing the size of the field. These soils generally are not suited to sanitary facilities in areas where the slope is more than 15 percent. A suitable alternative site should be selected. Dwellings should be designed so that they conform to the natural slope of the land, or building sites should be graded to a suitable gradient. Cutting and filling can provide a suitable grade for roads. Roads built on this soil need to be designed so that the surface pavement and base material are thick enough to compensate for the low strength of the soil. Coarser grained base material can be used to ensure better performance.

The capability unit is VIe-9, dryland. The Sully soil is in the Limy Upland range site, and the McConaughy soil is in the Silty range site. The Sully soil is in windbreak suitability group 8, and the McConaughy soil is in windbreak suitability group 3.

SmF—Sully-McConaughy complex, 9 to 30 percent slopes. These very deep, well drained, moderately steep and steep soils are on deeply dissected uplands. They formed in loess. The Sully soil is on convex shoulder slopes and the upper part of back slopes. The McConaughy soil is in the less sloping areas of linear or concave positions on the lower part of back slopes that have a slope of less than 15 percent. Areas range from 40 to several hundred acres in size. They are 50 to 70 percent Sully soil and 25 to 45 percent McConaughy soil. These two soils occur as areas so intricately mixed or so small in size that separating them in mapping is not practical.

Typically, the Sully soil has a surface layer of brown, friable loam about 3 inches thick. Next is a transitional layer of pale brown, friable, calcareous silt loam about 15 inches thick. The underlying material to a depth of more than 60 inches is pale brown and very pale brown, calcareous silt loam. In some areas the surface layer is less than 3 inches thick and is calcareous.

Typically, the McConaughy soil has a surface soil of grayish brown, friable loam about 13 inches thick. The subsoil is about 21 inches thick. It is brown, calcareous loam in the upper part, pale brown, calcareous very fine sandy loam in the next part, and very pale brown, calcareous loam in the lower part. The underlying material to a depth of more than 60 inches is very pale brown, calcareous very fine sandy loam.

Included with these soils in mapping are Duroc and Keith soils. Duroc and Keith soils have more clay in the control section than the Sully and McConaughy soils. Duroc soils have a mollic epipedon more than 20 inches thick. They are on toe slopes below the Sully and McConaughy soils. Keith soils have a subsoil that is better developed than that of the Sully and McConaughy soils. They are on less sloping summits above the Sully and McConaughy soils. Included soils make up 5 to 15 percent of the map unit.

Permeability is moderate in the Sully and McConaughy soils. The available water capacity is high. Runoff is medium or rapid. The organic matter content is moderately low in the Sully soil and moderate in the McConaughy soil.

Most of the acreage of these soils supports native grasses and is used as range. These soils are not suited to cultivated crops because of the slope and the severe hazard of water erosion. Range seeding may be needed in severely eroded areas that were previously used as cropland.

If these soils are used as range or hayland, the climax vegetation is dominantly little bluestem, sideoats

grama, and blue grama. These species make up 70 percent or more of the total annual forage. Plains muhly, needleandthread, western wheatgrass, sedges, and forbs make up the rest. If subject to continuous heavy grazing, big bluestem and little bluestem decrease in abundance and are replaced by western wheatgrass, needleandthread, plains muhly, sedges, and forbs. If overgrazing continues for many years, the native grasses lose vigor and are unable to stabilize the site. As a result, water erosion is excessive.

If the range is in excellent condition, the suggested initial stocking rate is 0.6 animal unit month per acre on the Sully soil and 0.7 animal unit month per acre on the McConaughy soil. A planned grazing system that includes proper grazing use and timely deferment of grazing and haying helps to maintain or improve the range condition. Properly located fences and livestock watering and salting facilities can result in a more uniform distribution of grazing. Areas previously used as cropland should be reseeded to a suitable grass mixture if they are used as range. In areas where gullies have formed because of severe water erosion, land shaping or other mechanical practices may be needed to smooth and stabilize the site before it is reseeded.

If this soil is used as hayland, the forage should be harvested only every other year. During the year the forage is not harvested, the hayland should be used only as fall or winter range. Mowing should be regulated so that the grasses remain vigorous and healthy.

These soils generally are unsuited to the trees and shrubs grown as windbreaks. The slope prevents the use of conventional tree-planting and tillage equipment. Some small areas are suitable sites for planting trees; however, onsite investigation is needed.

Land shaping and installing the distribution lines on the contour in areas of these soils help to ensure that septic tank absorption fields function properly. The moderate permeability is a limitation if these soils are used as a site for septic tank absorption fields. It generally can be overcome by increasing the size of the field. These soils generally are not suited to sanitary facilities in areas where the slope is more than 15 percent. A suitable alternative site should be selected. Dwellings should be designed so that they conform to the natural slope of the land, or building sites should be graded to a suitable gradient. Cutting and filling can provide a suitable grade for roads. Roads constructed in areas of these soils need to be designed so that the surface pavement and base material are thick enough to compensate for the low strength of these soils. Coarser grained base material can be used to ensure better performance.

The capability unit is VIe-9, dryland; windbreak suitability group 10. The Sully soil is in the Limy Upland range site, and the McConaughy soil is in the Silty range site.

TaG—Tassel-Otero-Rock outcrop complex, 15 to 60 percent slopes. This map unit consists of steep and very steep, somewhat excessively drained and well drained soils and areas of Rock outcrop on dissected uplands (fig. 12). The very shallow and shallow Tassel soil formed in material weathered from calcareous sandstone bedrock. It is on back slopes above and around the Rock outcrop. The very deep Otero soil formed in colluvial and alluvial sediments. It is on lower back slopes and foot slopes below the Tassel soil and Rock outcrop. It typically has a slope of less than 25 percent. The Rock outcrop is on ledges of upper side slopes and shoulder slopes. Areas range from 5 to 200 acres in size. They are 35 to 55 percent Tassel soil, 20 to 40 percent Otero soil, and 20 percent Rock outcrop. They are so intricately mixed that separating them in mapping is not practical.

Typically, the Tassel soil has a surface soil of grayish brown very fine sandy loam about 4 inches thick. Next is a transitional layer that is also grayish brown very fine sandy loam. It is about 3 inches thick. The underlying material is light brownish gray loamy very fine sand about 8 inches thick. Calcareous sandstone bedrock is at a depth of about 15 inches. In some areas the surface has a few stones. In other areas a few granitic pebbles are on the surface and throughout the profile.

Typically, the Otero soil has a surface soil of grayish brown very fine sandy loam about 5 inches thick. Next is a transitional layer of pale brown very fine sandy loam about 3 inches thick. The underlying material to a depth of more than 60 inches is very pale brown very fine sandy loam. In some areas the depth to bedrock is less than 60 inches. In places the surface soil may have dark colors more than 7 inches thick.

Typically, the areas of Rock outcrop consist of ledges and broken masses of calcareous sandstone bedrock. In some areas beds of sand and gravel are exposed.

Included with this unit in mapping are small areas of Dix and Sully soils. Dix and Sully soils are on upper back slopes above the Tassel and Otero soils and the areas of Rock outcrop. Dix soils have very gravelly coarse sand above a depth of 10 inches. Sully soils are very deep, silty soils that formed in loess.

Permeability is moderately rapid in the regolith of the Tassel soil. It is moderately rapid in the Otero soil. The available water capacity is very low in the Tassel soil and high in the Otero soil. Runoff is rapid or very rapid in both soils. The organic matter content is low.

Most of the acreage in this map unit supports native grasses and is used as range. The unit is not suited to

Figure 12.—An area of Tassel-Otero-Rock outcrop complex, 15 to 60 percent slopes, in the background. Bankard loamy sand, channeled, is in the foreground. These soils are used primarily as range.

cultivated crops because of the slope, the shallow rooting depth, and the areas of Rock outcrop.

If this map unit is as range, the climax vegetation is dominantly little bluestem, sideoats grama, sand bluestem, threadleaf sedge, and blue grama. These species make up 60 percent or more of the total annual forage. Prairie sandreed, needleandthread, and forbs make up the rest. If subject to continuous heavy grazing, sand bluestem and little bluestem decrease in abundance and are replaced by sideoats grama, blue grama, hairy grama, prairie sandreed, sand dropseed, threadleaf sedge, and forbs. If overgrazing continues for many years, woody plants may invade the site.

If the range is in excellent condition, the suggested initial stocking rate is 0.5 animal unit month per acre on the Tassel soil and 0.6 animal unit month per acre on the Otero soil. A planned grazing system that includes proper grazing use and timely deferment of grazing helps to maintain or improve the range condition. Properly located fences and livestock watering and salting facilities can result in a more uniform distribution of grazing. The slope can hinder the movement of livestock from one area to another. In some areas brush management may be needed to control the weedy plants that invade the site.

This map unit generally is unsuited to the trees and shrubs grown as windbreaks. The slope prevents the use of conventional tree-planting and tillage equipment. A few areas can support the trees and shrubs that enhance wildlife habitat if suitable species are planted by hand or if other special management is applied.

This map unit generally is not suited to sanitary facilities because of the slope and the shallow depth to bedrock. A suitable alternative site should be selected. Dwellings should be designed so that they conform to the natural slope of the land, or building sites should be graded to a suitable gradient. The soft bedrock generally can be excavated during the construction of

houses with basements or buildings that have deep foundations. Cutting and filling can provide a suitable grade for roads. The soft bedrock generally can be excavated during the construction of roads.

The capability unit is VIIs-4, dryland; windbreak suitability group 10. The Tassel soil is in the Shallow Limy range site, and the Otero soil is in the Limy Upland range site.

VdB—Valent fine sand, 0 to 3 percent slopes. This very deep, nearly level and very gently sloping, excessively drained soil is on low hummocks in the sandhills. It formed in sandy eolian material. Areas are irregular in shape and range from 5 to 500 acres in size.

Typically, the surface layer is dark grayish brown, loose fine sand about 8 inches thick. Next is a transitional layer of brown, loose fine sand about 9 inches thick. The underlying material to a depth of more than 60 inches is pale brown fine sand.

Included with this soil in mapping are small areas of Cullison and Ipage soils. Cullison soils have less sand in the control section. They have a mollic epipedon. They are in poorly drained and very poorly drained depressions. Ipage soils are moderately well drained. They are in concave valleys below the Valent soil. Included soils make up less than 10 percent of the map unit.

Permeability is rapid in the Valent soil, and the available water capacity is low. Runoff is slow. The organic matter content is low. The water intake rate is very high.

Most of the acreage of this soil supports native grasses and is used as range or hayland. Some small areas are irrigated with center-pivot irrigation systems. Corn and alfalfa are the principal crops in these areas.

These soils are not suited to dryland crops because of droughtiness and the severe hazard of soil blowing.

If irrigated, these soils are poorly suited to cultivated crops and introduced grasses. They are unsuited to gravity irrigation systems because they are sandy. They are best suited to sprinkler irrigation systems because frequent, light applications of water are needed. Soil blowing is a severe hazard. Leaving crop residue on the surface helps to control soil blowing. Fertilizers are easily leached below the root zone because of the high permeability. This leaching can be minimized if fertilizers are applied with a sprinkler irrigation system.

If this soil is used as range or hayland, the climax vegetation is dominantly sand bluestem, little bluestem, prairie sandreed, blue grama, and needleandthread. These species make up 70 percent or more of the total annual forage. Sand dropseed, switchgrass, and forbs make up the rest. If subject to continuous heavy grazing, sand bluestem, little bluestem, and switchgrass decrease in abundance and are replaced by needleandthread, prairie sandreed, Scribner panicum, blue grama, sand dropseed, and forbs. If overgrazing continues for many years, the native plants lose vigor and are unable to stabilize the site. As a result, soil blowing is excessive and blowouts can form.

If the range is in excellent condition, the suggested initial stocking rate is 0.7 animal unit month per acre. A planned grazing system that includes proper grazing use and timely deferment of grazing and haying helps to maintain or improve the range condition. Areas of this soil generally are the first to be overgrazed when it is in a pasture that includes Sands or Choppy Sands range sites. Properly located fences and livestock watering and salting facilities can result in a more uniform distribution of grazing. Areas previously used as cropland should be reseeded to a suitable grass mixture if they are used as range.

If this soil is used as hayland, the forage should be harvested only every other year. During the year the forage is not harvested, the hayland should be used only as fall or winter range. Mowing should be regulated so that the grasses remain vigorous and healthy.

This soil is suited to the trees and shrubs grown as windbreaks and to plantings that enhance recreational areas and wildlife habitat. The survival and growth rates of adapted species are fair. Soil blowing, the loose soil on the surface, and the lack of seasonal rainfall are hazards. Young seedlings can be damaged by windblown sand. Soil blowing can be controlled by maintaining strips of sod or cover crops between the tree rows. The trees need to be planted in shallow furrows with as little disturbance of the soil as possible. Irrigation can provide the moisture needed for establishing seedlings during dry periods. Hoeing by hand or rototilling help to control plant competition in the tree rows.

This soil readily absorbs but does not adequately filter the effluent in septic tank absorption fields. The poor filtering capacity can result in pollution of underground water supplies. The sides of shallow excavations can cave in unless they are shored. This soil generally is suited to dwellings and roads.

The capability units are VIe-5, dryland, and IVe-12, irrigated; Sandy range site; windbreak suitability group 7.

VdD—Valent fine sand, 3 to 9 percent slopes. This very deep, gently sloping and strongly sloping, excessively drained soil is on hummocks and dunes in the sandhills. It formed in sandy eolian material. Areas are irregular in shape and range from 5 to 500 acres in size.

Typically, the surface layer is grayish brown fine sand about 6 inches thick. Next is a transitional layer of brown, loose fine sand about 10 inches thick. The underlying material to a depth of more than 60 inches is pale brown and very pale brown fine sand. Blowouts may occur in places where soil blowing has removed all of the surface layer.

Included with this soil in mapping are small areas of Cullison and Ipage soils. Cullison soils have less sand in the control section than the Valent soil. They have a mollic epipedon. They are in poorly drained and very poorly drained depressions. Ipage soils are moderately well drained. They are in concave valleys below the Valent soil. Included soils make up less than 10 percent of the map unit.

Permeability is rapid in the Valent soil, and the available water capacity is low. Runoff is slow. The organic matter content is low. The water intake rate is very high.

Most of the acreage of this soil supports native grasses and is used as range or hayland. Some small areas are irrigated with center-pivot irrigation systems. Corn and alfalfa are the principal crops in these areas.

These soils are not suited to dryland crops because of droughtiness and the severe hazard of soil blowing.

If irrigated, these soils are poorly suited to cultivated crops and introduced grasses. They are unsuited to gravity irrigation systems because they are too sandy. They are best suited to sprinkler irrigation systems because frequent, light applications of water are needed. Soil blowing is a severe hazard. Leaving crop residue on the surface helps to control soil blowing. Fertilizers are easily leached below the root zone because of the high permeability. This leaching can be minimized if fertilizers are applied with a sprinkler irrigation system.

If this soil is used as range or hayland, the climax vegetation is dominantly sand bluestem, little bluestem, prairie sandreed, and needleandthread. These species make up 70 percent or more of the total annual forage. Blue grama, switchgrass, sand lovegrass, sedges, and forbs make up the rest. If subject to continuous heavy grazing, sand bluestem, sand lovegrass, little bluestem, and switchgrass decrease in abundance and are replaced by needleandthread, blue grama, sand dropseed, sedges, and forbs. If overgrazing continues for many years, the native plants lose vigor and are unable to stabilize the site. As a result, soil blowing is excessive and blowouts can form.

If the range is in excellent condition, the suggested initial stocking rate is 0.7 animal unit month per acre. A planned grazing system that includes proper grazing use and timely deferment of grazing and haying helps to maintain or improve the range condition. Properly located fences and livestock watering and salting facilities can result in a more uniform distribution of grazing. Areas previously used as cropland should be reseeded to a suitable grass mixture if they are used as range.

If this soil is used as hayland, the forage should be harvested only every other year. During the year the forage is not harvested, the hayland should be used only as fall or winter range. Mowing should be regulated so that the grasses remain vigorous and healthy.

This soil is suited to the trees and shrubs grown as windbreaks and to plantings that enhance recreational areas and wildlife habitat. The survival and growth rates of adapted species are fair. Soil blowing, the loose soil on the surface, and the lack of seasonal rainfall are hazards. Young seedlings can be damaged by windblown sand. Soil blowing can be controlled by maintaining strips of sod or cover crops between the tree rows. The trees need to be planted in shallow furrows with as little disturbance of the soil as possible. Irrigation can provide the needed moisture for establishing seedlings during dry periods. Hoeing by hand or rototilling help to control plant competition in the tree rows.

This soil readily absorbs but does not adequately filter the effluent in septic tank absorption fields. The poor filtering capacity can result in pollution of underground water supplies. The sides of shallow excavations can cave in unless they are shored. This soil generally is suited to dwellings and roads.

The capability units are VIe-5, dryland, and IVe-12, irrigated; Sands range site; windbreak suitability group 7.

VdE—Valentine fine sand, rolling. This deep, moderately steep to steep, excessively drained soil is on uplands in the sandhills. It formed in sandy eolian material. Slopes range from 9 to 24 percent. Areas of this unit are irregular in shape and range from 5 to more than 1,000 acres in size.

Typically, the surface layer is grayish brown, loose fine sand about 6 inches thick. Next is a transitional layer of pale brown, loose fine sand about 5 inches thick. The underlying material to a depth of more than 60 inches is very pale brown, loose fine sand. Blowouts may occur in places where soil blowing has removed all of the surface layer.

Included with this soil in mapping are small areas of Gannett and Ipage soils. Gannett soils have less sand in the control section than the Valentine soil. They have a mollic epipedon. They are in poorly and very poorly drained depressions. Ipage soils are moderately well drained. They are in concave valleys below the

Valentine soil. Included soils make up less than 10 percent of the map unit.

Permeability is rapid in the Valentine soil, and the available water capacity is low. Runoff is slow. The organic matter content is low.

Most of the acreage of this soil supports native grasses and is used as range or hayland.

This soil is not suited to dryland and irrigated crops because of the slope, droughtiness, and the severe hazard of soil blowing.

If this soil is used as range or hayland, the climax vegetation is dominantly sand bluestem, little bluestem, prairie sandreed, and needleandthread. These species make up 70 percent or more of the total annual forage. Blue grama, switchgrass, sand lovegrass, sedges, and forbs make up the rest. If subject to continuous heavy grazing, sand bluestem, sand lovegrass, little bluestem, and switchgrass decrease in abundance and are replaced by needleandthread, blue grama, sand dropseed, sedges, and forbs. If overgrazing continues for many years, the native plants lose vigor and are unable to stabilize the site. As a result, soil blowing is excessive and blowouts can form.

If the range is in excellent condition, the suggested initial stocking rate is 0.7 animal unit month per acre. A planned grazing system that includes proper grazing use and timely deferment of grazing and haying helps to maintain or improve the range condition. Properly located fences and livestock watering and salting facilities can result in a more uniform distribution of grazing. Areas previously used as cropland should be reseeded to a suitable grass mixture if they are used as range.

If this soil is used as hayland, the forage should be harvested only every other year. During the year the forage is not harvested, the hayland should be used only as fall or winter range. Mowing should be regulated so that the grasses remain vigorous and healthy.

This soil is suited to the trees and shrubs grown as windbreaks and to plantings that enhance recreational areas and wildlife habitat. The survival and growth rates of adapted species are fair. Soil blowing, the loose soil on the surface, and a lack of seasonal rainfall are hazards. Young seedlings can be damaged by windblown sand. Soil blowing can be controlled by maintaining strips of sod or cover crops between the tree rows. The trees need to be planted in shallow furrows with as little disturbance of the soil as possible. Irrigation can provide the moisture needed for establishing seedlings during dry periods. Hoeing by hand or rototilling help to control plant competition in the tree rows.

This soil readily absorbs but does not adequately filter the effluent in septic tank absorption fields. The poor filtering capacity can result in pollution of underground water supplies. The sides of shallow excavations can cave in unless they are shored. Dwellings should be designed so that they conform to the natural slope of the land, or the site should be graded to a suitable gradient. Cutting and filling can provide a suitable grade for roads.

The capability unit is VIe-5, dryland; Sands range site; windbreak suitability group 7.

VdF—Valentine fine sand, rolling and hilly. This deep, steep to very steep, excessively drained soil is on uplands in the sandhills. It formed in sandy eolian material. Slopes range from 14 to 45 percent. Areas are irregular in shape and range from 40 to more than 1,000 acres in size. They are 40 to 70 percent Valentine, rolling, soil and 20 to 50 percent Valentine, hilly, soil.

Typically, the surface layer is brown, loose fine sand about 4 inches thick. The underlying material to a depth of more than 60 inches is very pale brown fine sand. Blowouts are common.

Included with this soil in mapping are small areas of Gannett and Ipage soils. Gannett soils have less sand in the control section than the Valentine soil. They have a mollic epipedon. They are in poorly and very poorly drained depressions. Ipage soils are moderately well drained. They are in concave valleys below the Valentine soil. Included soils make up less than 10 percent of the map unit.

Permeability is rapid in the Valentine soil, and the available water capacity is low. Runoff is slow. The organic matter content is low.

Most of the acreage of this soil supports native grasses and is used as range.

This soil is not suited to dryland or irrigated crops because of the slope, droughtiness, and the severe hazard of soil blowing.

If this soil is used as range, the climax vegetation is dominantly sand bluestem, little bluestem, prairie sandreed, and needleandthread. These species make up 70 percent or more of the total annual forage. Blue grama, switchgrass, sand lovegrass, sedges, and forbs make up the rest. If subject to continuous heavy grazing, sand bluestem, sand lovegrass, little bluestem, and switchgrass decrease in abundance and are replaced by needleandthread, blue grama, sand dropseed, sedges, and forbs. If overgrazing continues for many years, the native plants lose vigor and are unable to stabilize the site. As a result, soil blowing is excessive and blowouts can form.

If the range is in excellent condition, the suggested initial stocking rate is 0.7 animal unit month per acre on the Valentine, rolling, soil and 0.6 animal unit month per

acre on the Valentine, hilly, soil. A planned grazing system that includes proper grazing use and timely deferment of grazing helps to maintain or improve the range condition. Properly located fences and livestock watering and salting facilities can result in a more uniform distribution of grazing. Areas previously used as cropland should be reseeded to a suitable grass mixture if they are used as range.

This soil generally is unsuited to the trees and shrubs grown as windbreaks. The slope prevents the use of conventional tree-planting and tillage equipment. Some small areas are suitable sites for planting trees; however, onsite investigation is needed.

This soil generally is not suited to sanitary facilities because of the slope. A suitable alternative site should be selected. The sides of shallow excavations can cave in unless they are shored. Dwellings should be designed so that they conform to the natural slope of the land, or the site should be graded to a suitable gradient. Cutting and filling can provide a suitable grade for roads.

The capability unit is VIIe-5, dryland; Sands, Choppy Sands range site; windbreak suitability group 10.

VgG—Valentine fine sand, gullied, 30 to 60 percent slopes. This deep, very steep, excessively drained soil is on dissected upland breaks. Gullies are common. This soil formed in sandy eolian material. Areas are irregular in shape and range from 20 to more than 400 acres in size.

Typically, the surface layer is brown, loose fine sand about 3 inches thick. The underlying material to a depth of more than 60 inches is pale brown fine sand.

Included with this soil in mapping are small areas of the very poorly drained Marlake soils. These soils are in drainageways. They make up less than 10 percent of the map unit.

Permeability is rapid in the Valentine soil, and the available water capacity is low. Runoff is slow. The organic matter content is low.

Most of the acreage of this soil supports native grasses and is used as range.

These soils are not suited to dryland or irrigated crops because of the slope, droughtiness, and the severe hazards of water erosion and soil blowing.

If this soil is used as range, the climax vegetation is dominantly sand bluestem, little bluestem, switchgrass, prairie sandreed, and needleandthread. These species make up 70 percent or more of the total annual forage. Sand lovegrass, sandhill muhly, and forbs make up the rest. If subject to continuous heavy grazing, sand bluestem, sand lovegrass, little bluestem, and switchgrass decrease in abundance and are replaced by needleandthread, hairy grama, prairie sandreed, sand dropseed, sandhill muhly, sedges, and forbs. If overgrazing continues for many years, the native plants lose vigor and are unable to stabilize the site. As a result, soil blowing is excessive and blowouts can form.

If the range is in excellent condition, the suggested initial stocking rate is 0.6 animal unit month per acre. A planned grazing system that includes proper grazing use and timely deferment of grazing helps to maintain or improve the range condition. Because of the slope, it is difficult for livestock to graze in areas of this soil.

This soil generally is unsuited to the trees and shrubs grown as windbreaks. The slope prevents the use of conventional tree-planting and tillage equipment. Some small areas are suitable sites for planting trees; however, onsite investigation is needed.

This soil generally is not suited to sanitary facilities because of the slope. A suitable alternative site should be selected. The sides of shallow excavations can cave in unless they are shored. Dwellings should be designed so that they conform to the natural slope of the land, or the site should be graded to a suitable gradient. Cutting and filling can provide a suitable grade for roads.

The capability unit is VIIe-5, dryland; Choppy Sands range site; windbreak suitability group 10.

VtG—Valent-Tassel-Rock outcrop complex, 9 to 60 percent slopes. This map unit consists of moderately steep to very steep, excessively drained and somewhat excessively drained soils and areas of Rock outcrop on dissected sandhill breaks. The very deep Valent soils are in convex positions above the Tassel soil and Rock outcrop. The very shallow and shallow Tassel soils are above and around the Rock outcrop. Areas range from 5 to 200 acres in size. They are 40 to 60 percent Valent soil, 20 to 40 percent Tassel soil, and 15 to 30 percent Rock outcrop. They are so intricately mixed that separating them in mapping is not practical.

Typically, the Valent soil has a surface soil of grayish brown fine sand about 3 inches thick. Next is a transitional layer of pale brown fine sand about 9 inches thick. The underlying material to a depth of more than 60 inches is very pale brown fine sand. In some areas the depth to bedrock is less than 60 inches. In places the surface soil may have dark colors more than 7 inches thick.

Typically, the Tassel soil has a surface soil of grayish brown fine sandy loam about 4 inches thick. Next is a transitional layer of brown fine sandy loam about 5 inches thick. The underlying material is pale brown fine sandy loam about 4 inches thick. White, calcareous sandstone bedrock is at a depth of about 13 inches.

The areas of Rock outcrop consist of ledges and broken masses of calcareous sandstone bedrock. In

some areas beds of sand and gravel are exposed.

Included with this unit in mapping are small areas of Dix and Sarben soils. Dix and Sarben soils are commonly in landscape positions higher than those of the Valent and Tassel soils and the areas of Rock outcrop. Dix soils have very gravelly coarse sand above a depth of 10 inches. Sarben soils are very deep. They have more silt and less sand in the control section than the Valent and Tassel soils and the areas of Rock outcrop. Included soils make up less than 20 percent of the map unit.

Permeability is rapid in the Valent soil. It is moderately rapid in the regolith of the Tassel soil. The available water capacity is low or very low in both soils. Runoff is rapid or very rapid. The organic matter content is low.

Most of the acreage of this map unit supports native grasses and is used as range. The unit is unsuited to cropland because of the slope, the shallow rooting depth, and the areas of Rock outcrop.

If this map unit is used as range, the climax vegetation is dominantly sand bluestem, little bluestem, prairie sandreed, and needleandthread. These species make up 70 percent or more of the total annual forage. Blue grama, switchgrass, sand lovegrass, sedges, and forbs make up the rest. If subject to continuous heavy grazing, sand bluestem, sand lovegrass, little bluestem, and switchgrass decrease in abundance and are replaced by needleandthread, blue grama, sand dropseed, sedges, and forbs. If overgrazing continues for many years, the native plants lose vigor and are unable to stabilize the site. As a result, soil blowing is excessive and blowouts can form.

If the range is in excellent condition, the suggested initial stocking rate is 0.7 animal unit month per acre on the Valent soil and 0.5 animal unit month per acre on the Tassel soil. A planned grazing system that includes proper grazing use and timely deferment of grazing helps to maintain or improve the range condition. Properly located fences and livestock watering and salting facilities can result in a more uniform distribution of grazing. The slope can hinder the movement of livestock from one area to another. In some areas brush management may be needed to control the weedy plants that invade the site.

This map unit generally is unsuited to the trees and shrubs grown as windbreaks. The slope prevents the use of conventional tree-planting and tillage equipment. A few areas can support the trees and shrubs that enhance wildlife habitat if suitable species are planted by hand or if other special management is applied.

This map unit generally is not suited to sanitary facilities because of the slope and the shallow depth to bedrock. A suitable alternative site should be selected. Dwellings should be designed so that they conform to the natural slope of the land, or building sites should be graded to a suitable gradient. Cutting and filling can provide a suitable grade for roads.

The capability unit is VIIs-4, dryland; windbreak suitability group 10. The Valent soil is in the Sands range site, and the Tassel soil is in the Shallow Limy range site.

VwB—Vetal loamy fine sand, 0 to 3 percent slopes. This very deep, nearly level and very gently sloping, well drained soil is in swales on uplands. It formed in sandy and loamy colluvial and eolian material. Areas range from 5 to more than 100 acres in size.

Typically, the surface layer is grayish brown, very friable loamy fine sand about 8 inches thick. The subsurface layer is dark grayish brown and dark gray, friable very fine sandy loam about 24 inches thick. Next is a transitional layer of brown, very friable very fine sandy loam about 6 inches thick. The underlying material to a depth of 60 inches or more is pale brown loamy fine sand. In some areas the dark color of the surface layer is less than 20 inches thick.

Included with this soil in mapping are small areas of Sarben and Valent soils. These soils do not have a mollic epipedon. They are in landscape positions higher than those of the Vetal soil. Valent soils have more sand in the control section than the Vetal soil.

Permeability is moderately rapid in the Vetal soil, and the available water capacity is moderate. Runoff is slow. The organic matter content is moderately low. The water intake rate is high.

Most of the acreage of this soil is used for cultivated crops. Some areas are irrigated if water is available. The remaining acreage is used as range or pasture.

If dry-farmed, this soil is poorly suited to wheat, legumes, and introduced grasses. Insufficient rainfall during the growing season is the major limitation. Soil blowing is a major hazard in areas where the surface is not adequately protected by crops or crop residue. A system of conservation tillage, such as chiseling or disking, that leaves crop residue on the surface helps to control soil blowing and conserve moisture. Leaving crop residue on the surface and growing green manure crops help to improve and maintain organic matter content and fertility. Summer fallowing is needed if wheat is grown.

If irrigated, this soil is suited to corn, wheat, and beans. Alfalfa and introduced grasses can be grown for hay or pasture. Soil blowing is a hazard in areas where the surface is not adequately protected by crops or crop residue. A system of conservation tillage, such as chiseling or disking, that leaves crop residue on the

surface helps to control soil blowing and conserve moisture. Leaving crop residue on the surface, growing green manure crops, and applying feedlot manure help to improve and maintain organic matter content and fertility.

This soil is suited to range and native hay. A cover of range plants is effective in controlling soil blowing. Overgrazing or improper haying methods reduce the amount of protective cover and the quality of native plants. As a result, soil blowing is excessive and small blowouts can form. Proper grazing use, timely deferment of grazing and haying, and a planned grazing system help to keep the native plants in good condition. Range seeding may be needed to stabilize severely eroded areas of cropland.

This soil is suited to the trees and shrubs grown as windbreaks and to plantings that enhance recreational areas and wildlife habitat. The survival and growth rates of adapted species are fair. The lack of seasonal rainfall and soil blowing are hazards. Soil blowing can be controlled by maintaining strips of sod or cover crops between the tree rows. Irrigation can provide the moisture needed during dry periods. Hoeing by hand, rototilling, and applying the appropriate herbicide help to control plant competition in the tree rows.

This soil generally is suited to septic tank absorption fields and dwellings. The damage to roads caused by frost action cam be minimized by a good surface drainage system. Crowning the road by grading and constructing adequate roadside ditches help to provide the needed surface drainage.

The capability units are IIIe-5, dryland, and IIIe-10, irrigated; Sandy range site; windbreak suitability group 5.

Wa—Wann fine sandy loam, 0 to 2 percent slopes. This very deep, nearly level, somewhat poorly drained soil is on high bottom land. It formed in stratified, calcareous, loamy alluvium. It is subject to rare flooding. Areas range from 5 to 100 acres in size.

Typically, the surface soil is dark gray, friable fine sandy loam about 14 inches thick. Next is a transitional layer of grayish brown, friable fine sandy loam about 4 inches thick. The underlying material extends to a depth of more than 60 inches. It is stratified grayish brown, gray, and light brownish gray sandy loam and fine sandy loam in the upper part and light gray fine sand in the lower part. In a few small areas the surface layer is loam or sandy loam. In places sand and gravelly sand are below a depth of 40 inches.

Included with this soil in mapping are small areas of Alda, Lex, and Norwest soils. These soils are in landscape positions similar to those of the Wann soil. Alda soils have coarse sand at a depth of 20 to 40 inches. Lex and Norwest soils have more clay in the control section than the Wann soil. Lex soils have gravelly coarse sand at a depth of 20 to 40 inches. Included soils make up 5 to 15 percent of the map unit.

Permeability is moderately rapid in the Wann soil, and the available water capacity is moderate. Runoff is slow. The organic matter content is moderately low. The water intake rate is moderately high. The seasonal high water table ranges from a depth of about 1.5 feet during wet years to about 3.5 feet during dry years.

Most of the acreage of this soil is used for cultivated crops. About half of the acreage is irrigated. The remaining acreage is used as pasture or hayland.

If dry-farmed, this soil is suited to alfalfa and wheat. Introduced grasses can be grown for hay or pasture. The major hazards are soil blowing in areas where the surface is not adequately protected by crops or crop residue and flooding. The major limitation is wetness. A system of conservation tillage, such as disking or chiseling, that leaves crop residue on the surface helps to control soil blowing and conserve moisture. Constructing dikes helps to control flooding. Leaving crop residue on the soil, growing green manure crops, and applying feedlot manure help to improve and maintain organic matter content, fertility, and tilth.

If irrigated, this soil is suited to alfalfa, corn, beans, and introduced grasses. The main hazards are the flooding and soil blowing in areas where the surface is not adequately protected by crops or crop residue. The soil may be difficult to work in spring because of the wetness caused by the high water table. Constructing dikes can help to control flooding. A system of conservation tillage, such as disking or chiseling, that leaves crop residue on the surface helps to control soil blowing and conserves moisture. Using tile drains to lower the water table can help reduce wetness early in the spring. Returning crop residue to the soil and applying green manure crops and feedlot manure help to maintain or improve organic matter content and fertility.

This soil is suited to range and native hay. Continuous heavy grazing or improper haying methods reduce the amount of protective cover and the quality of native plants. Overgrazing when the soil is wet can result in surface compaction and the formation of small mounds, which make grazing and harvesting hay difficult. Proper grazing use, timely deferment of grazing and haying, and restricted use during wet periods help to keep the native plants in good condition.

This soil is suited to the trees and shrubs grown as windbreaks and to plantings that enhance recreational areas and wildlife habitat. Trees and shrubs that can withstand the wetness survive and grow well. Weeds and undesirable grasses that compete with the trees for

moisture, a lack of seasonal rainfall, and soil blowing that damages seedlings are limitations. The weeds and undesirable grasses can be controlled by timely cultivation or by applications of the appropriate herbicide. Irrigation can provide the moisture needed during dry periods. Soil blowing can be controlled by planting a cover crop between the tree rows.

If this soil is used as site for septic tank absorption fields, fill material is needed to raise the absorption field a sufficient distance above the seasonal high water table. The sides of shallow excavations can cave in unless they are shored. Shoring should be completed during dry periods. Constructing dwellings on raised, well compacted fill material helps to overcome the wetness. The damage to roads caused by frost action can be minimized by a good surface drainage system and by a gravel moisture barrier in the subgrade. Crowning the road by grading and constructing adequate roadside ditches help to provide the needed surface drainage.

The capability units are IIw-6, dryland, and IIw-8, irrigated; Subirrigated range site; windbreak suitability group 2S.

Prime Farmland

Prime farmland is one of several kinds of important farmland defined by the U.S. Department of Agriculture. It is of major importance in meeting the Nation's short- and long-range needs for food and fiber. Because the supply of high-quality farmland is limited, the U.S. Department of Agriculture recognizes that responsible levels of government, as well as individuals, should encourage and facilitate the wise use of our Nation's prime farmland.

Prime farmland, as defined by the U.S. Department of Agriculture, is the land that is best suited to food, feed, forage, fiber, and oilseed crops. It may be cultivated land, pasture, woodland, or other land, but it is not urban or built-up land or water areas. It either is used for food or fiber crops or is available for those crops. The soil qualities, growing season, and moisture supply are those needed for a well managed soil to produce a sustained high yield of crops in an economic manner. Prime farmland produces the highest yields with minimal expenditure of energy and economic resources, and farming it results in the least damage to the environment.

Prime farmland has an adequate and dependable supply of moisture from precipitation or irrigation. The temperature and growing season are favorable. The level of acidity or alkalinity is acceptable. Prime farmland has few or no rocks and is permeable to water and air. It is not excessively erodible or saturated with water for long periods and is not frequently flooded during the growing season. The slope ranges mainly from 0 to 6 percent. More detailed information about the criteria for prime farmland is available at the local office of the Natural Resources Conservation Service.

About 206,500 acres in the survey area, or 29 percent of the total acreage, meets the soil requirements for prime farmland. Most of this land is in the southern and southwestern parts of the county, in associations 6, 7, and 8, which are described under the heading "General Soil Map Units." Nearly all of this prime farmland is used for crops, mainly corn, wheat, and alfalfa.

The map units in the survey area that are considered prime farmland are listed in table 5. This list does not constitute a recommendation for a particular land use. The extent of each listed map unit is shown in table 4. The location is shown on the detailed soil maps at the back of this publication. The soil qualities that affect use and management are described under the heading "Detailed Soil Map Units."

Some soils that have a seasonal high water table and all soils that receive an inadequate amount of rainfall qualify as prime farmland only in areas where these limitations have been overcome by drainage measures or irrigation. The need for these measures is indicated after the map unit name in table 5. Onsite evaluation is needed to determine whether or not these limitations have been overcome by corrective measures.

Use and Management of the Soils

This soil survey is an inventory and evaluation of the soils in the survey area. It can be used to adjust land uses to the limitations and potentials of natural resources and the environment. Also, it can help to prevent soil-related failures in land uses.

In preparing a soil survey, soil scientists, conservationists, engineers, and others collect extensive field data about the nature and behavioral characteristics of the soils. They collect data on erosion, droughtiness, flooding, and other factors that affect various soil uses and management. Field experience and collected data on soil properties and performance are used as a basis in predicting soil behavior.

Information in this section can be used to plan the use and management of soils for crops and pasture; as rangeland; for windbreaks and environmental plantings; as sites for buildings, sanitary facilities, highways and other transportation systems, and parks and other recreational facilities; and for wildlife habitat. It can be used to identify the potentials and limitations of each soil for specific land uses and to help prevent construction failures caused by unfavorable soil properties.

Planners and others using soil survey information can evaluate the effect of specific land uses on productivity and on the environment in all or part of the survey area. The survey can help planners to maintain or create a land use pattern in harmony with the natural soil.

Contractors can use this survey to locate sources of sand and gravel, roadfill, and topsoil. They can use it to identify areas where bedrock, wetness, or very firm soil layers can cause difficulty in excavation.

Health officials, highway officials, engineers, and others may also find this survey useful. The survey can help them plan the safe disposal of wastes and locate sites for pavements, sidewalks, campgrounds, playgrounds, lawns, and trees and shrubs.

The soils in this survey area are assigned to various interpretive groups at the end of each map unit description and in some of the tables. The groups for each map unit also are shown under the heading "Interpretive Groups," which follows the tables at the back of this survey.

This publication includes suggested management practices that are intended to increase crop production and control soil blowing and water erosion. Over time, some or all of these conservation practices may or may not be in accordance with Federal, State, and local laws and with agency rules and guides.

Crops and Pasture

Roger Kanable, conservation agronomist, Natural Resources Conservation Service, helped prepare this section.

General management needed for crops and pasture is suggested in this section. The crops or pasture plants best suited to the soils, including some not commonly grown in the survey area, are identified; the system of land capability classification used by the Natural Resources Conservation Service is explained; and the estimated yields of the main crops and hay and pasture plants are listed for each soil.

Planners of management systems for individual fields or farms should consider the detailed information given in the description of each soil under the heading "Detailed Soil Map Units." Specific information can be obtained from the local office of the Natural Resources Conservation Service or the Cooperative Extension Service.

Approximately 34 percent of the agricultural land in Keith County is cropland. About 43 percent of the cropland is irrigated. Corn and wheat are the main crops. Other crops grown include dry beans, soybeans, and alfalfa.

Dryland Farm Management

The areas used for wheat-fallow rotation are interspersed with irrigated cropland south of the North Platte River.

Insufficient rainfall commonly is a limiting factor affecting crop production in the county. Water erosion and soil blowing can prevent maximum crop production. Good management in areas used for dryland crops

helps to control soil blowing and water erosion, conserves moisture, and improves tilth.

Stripcropping and a conservation tillage system that keeps crop residue on the surface help to control soil blowing and water erosion. Keeping crop residue on the surface or growing a protective plant cover minimizes crusting during and after heavy rains. In winter the stubble holds snow on the field and thus increases the moisture supply. Terraces reduce the length of slopes and thus reduce the runoff rate and help to control erosion. Level terraces are most practical on the long, smooth, moderately sloping upland soils. Push-up terraces are most practical on the steeper slopes.

In Keith County, erosion is the major problem on the soils used as cropland and in the areas of pasture that have been overgrazed. Nearly all the soils are susceptible to soil blowing, and many are susceptible to water erosion. Soil blowing is most severe during March, April, and May when the wind is mostly from the north-northwest.

Soil blowing is a major problem in areas of the Valent, Sarben-Vetal, and Sully-Dix-Tassel associations. Keeping crop residue on the surface until spring planting helps to control soil blowing.

Contour stripcropping, wind stripcropping, and a system of conservation tillage that leaves crop residue on the surface help to control soil blowing and water erosion. Contour stripcropping is best suited to soils in areas where water erosion and soil blowing are problems. The strips should be perpendicular to the prevailing wind.

Soil blowing reduces productivity and causes damage to growing crops and to rangeland.

A cropping system and management practices that control erosion and conserve soil moisture are needed on all the cropland in the county. Proper management practices and a suitable cropping sequence help to maintain tilth, fertility, and a plant cover that protects the soil from erosion and help to control weeds, insects, and diseases.

The management practices and cropping sequence vary depending on the kind of soil. For example, management and vegetative practices are needed to control erosion in areas of Satanta loam, 0 to 1 percent slopes. Management, vegetative, and mechanical practices may be needed in areas of Sully loam, 6 to 9 percent slopes.

Occasionally, tillage is needed to prepare a seedbed and to control weeds. Excessive tillage reduces the extent of the plant cover and increases the hazard of erosion. Tilling in the fall should be avoided in areas where erosion is a hazard. Tillage practices should be limited to those that are essential. Various methods of conservation tillage are used in the county. Ecofallow, no-till planting, disk-plant, and chisel-plant systems are well suited to all the commonly grown crops. Grasses and legumes can be established without further seedbed preparation by drilling into a cover of stubble.

Soil tilth is an important factor affecting the germination of seeds and the infiltration of water into the soil. Soils with good tilth are granular and porous. Regular additions of crop residue, manure, and other organic material improve soil structure and tilth.

Soil fertility is lower in the eroded soils and the moderately deep soils. All soils, however, require additional plant nutrients for optimum production. The kind and amount of fertilizer to be applied to the soils used for dryland crops should be based on the results of soil tests. Nitrogen and phosphorus are the elements added to most cultivated areas. In some areas trace elements are needed. All fertilizers should be applied in a manner that reduces the risk of contamination of surface water and ground water.

Irrigation Management

About 43 percent of the cropland in Keith County is irrigated. Corn is grown on a majority of the irrigated cropland. A smaller acreage is used for alfalfa hay, field beans, and other crops. The irrigation water is obtained from wells and the Platte River system. Gravity or sprinkler systems are suited to the areas used for row crops. Alfalfa is generally irrigated by sprinkler systems.

The cropping sequence on soils that are well suited to irrigation consists mostly of row crops. A crop rotation that includes different crops, such as corn and dry beans, helps to control the diseases and insects that are common if the same crop is grown year after year.

Gently sloping soils, such as Satanta loam, 3 to 6 percent slopes, are subject to water erosion if they are furrow irrigated down the slope. If furrow irrigated, these soils should be contour bench leveled, or contour furrows should be used in combination with a ridge-till conservation tillage system. Land leveling increases the efficiency of furrow irrigation because it results in an even distribution of water. The efficiency of a furrow system can be improved by installing a tailwater recovery system.

A tailwater recovery pit can be installed to trap excess irrigation tailwater. This water can then be pumped back onto the field and used again. This practice increases the efficiency of the irrigation system and conserves the supply of underground water.

Contour farming and conservation tillage practices that keep crop residue on the surface help to control soil blowing and water erosion on soils irrigated by a sprinkler system. When water is applied by the sprinklers at a controlled rate, it is absorbed by the soil

and does not run off the surface. Sprinklers can be used on the more sloping soils and on the nearly level soils. Some soils, such as Keith loam, 3 to 6 percent slopes, are suited to sprinkler irrigation only if erosion is controlled. Because the application of water can be carefully regulated, sprinklers can be used for special purposes, such as establishing a new pasture on moderately steep soils. The most common type of sprinkler irrigation in Keith County is the center-pivot system.

Irrigation is most efficient if it is started after the plants have used about half of the available water in the soil. Thus, if a soil holds 8 inches of available water, irrigation should be started when about 4 inches has been removed by the crop.

All of the soils in Nebraska are assigned to irrigation design groups *(6)*.

Assistance in planning and designing an irrigation system can be obtained from the local office of the Natural Resources Conservation Service or from the Cooperative Extension Service. Estimates of the cost of irrigation equipment can be obtained from local dealers and manufacturers.

Weed Control

A suitable cropping sequence or appropriate herbicides help to control weeds. Rotating different crops in a planned sequence not only helps to control weeds but also increases the productivity of the soil and the content of organic matter. The kind and amount of herbicide applied to the soil should be carefully controlled. The colloidal clay and humus fractions of the soil are responsible for most of the chemical activity in the soil. Applications of an excessive amount of herbicide can cause crop damage on sandy soils that have a low content of colloidal clay and on soils that have a moderately low or low content of organic matter. The herbicide should be applied in a manner that reduces the risk of contamination of surface water and ground water. The Cooperative Extension Service can provide additional information about weed control.

Management of Pasture and Hayland

Pasture or hayland should be managed for maximum forage production. After a pasture is established, the grasses should be kept productive. In Keith County pastures of introduced grasses consist mainly of cool-season grasses. These grasses start to grow early in the spring and reach their peak growth in May and June. They are dormant during July and August unless the pasture is irrigated. They start to grow again in the fall. For this reason, these cool-season grasses should be managed in a planned grazing system along with pastures of warm-season grasses. The management should include rotation grazing to allow regrowth of the grasses and an extension of the grazing season. Introduced pasture grasses can be grazed in the spring after they reach a height of 5 or 6 inches. Until plants reach this height, they grow on food reserves stored in their roots and rhizomes. Grazing too early in the spring or too late in the fall reduces the vigor of the plants. The most commonly grown introduced grasses in cool-season pastures in the county are intermediate wheatgrass and pubescent wheatgrass. Other cool-season grasses and legumes that are adapted to the soils and climate in Keith County are bromegrass, creeping foxtail, meadow bromegrass, reed canarygrass, and alfalfa.

Yields per Acre

The average yields per acre that can be expected of the principal crops under a high level of management are shown in table 6. In any given year, yields may be higher or lower than those indicated in the table because of variations in rainfall and other climatic factors. The land capability classification also is shown in the table.

The yields are based mainly on the experience and records of farmers, conservationists, and extension agents. Available yield data from nearby counties and results of field trials and demonstrations are also considered.

The management needed to obtain the indicated yields of the various crops depends on the kind of soil and the crop. Management can include drainage, erosion control, and protection from flooding; the proper planting and seeding rates; suitable high-yielding crop varieties; appropriate and timely tillage; control of weeds, plant diseases, and harmful insects; favorable soil reaction and optimum levels of nitrogen, phosphorus, potassium, and trace elements for each crop; effective use of crop residue, barnyard manure, and green manure crops; and harvesting that ensures the smallest possible loss.

For yields of irrigated crops, it is assumed that the irrigation system is adapted to the soils and to the crops grown, that good-quality irrigation water is uniformly applied as needed, and that tillage is kept to a minimum.

The estimated yields reflect the productive capacity of each soil for each of the principal crops. Yields are likely to increase as new production technology is developed. The productivity of a given soil compared with that of other soils, however, is not likely to change.

Crops other than those shown in table 6 are grown in the survey area, but estimated yields are not listed because the acreage of such crops is small. The local office of the Natural Resources Conservation Service or

of the Cooperative Extension Service can provide information about the management and productivity of the soils for those crops.

Land Capability Classification

Land capability classification shows, in a general way, the suitability of soils for most kinds of field crops. Crops that require special management are excluded. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. The criteria used in grouping the soils do not include major and generally expensive landforming that would change slope, depth, or other characteristics of the soils, nor do they include possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for rangeland, for windbreaks, or for engineering purposes.

In the capability system, soils are generally grouped at three levels—capability class, subclass, and unit. These levels are defined in the following paragraphs.

Capability classes, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class I soils have few limitations that restrict their use.

Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Class III soils have severe limitations that reduce the choice of plants or that require special conservation practices, or both.

Class IV soils have very severe limitations that reduce the choice of plants or that require very careful management, or both.

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use.

Class VI soils have severe limitations that make them generally unsuitable for cultivation.

Class VII soils have very severe limitations that make them unsuitable for cultivation.

Class VIII soils and miscellaneous areas have limitations that nearly preclude their use for commercial crop production.

Capability subclasses are soil groups within one class. They are designated by adding a small letter, *e*, *w*, *s*, or *c*, to the class numeral, for example, IIe. The letter *e* shows that the main hazard is the risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the United States, shows that the chief limitation is climate that is very cold or very dry.

In class I there are no subclasses because the soils of this class have few limitations. Class V contains only the subclasses indicated by *w*, *s*, or *c* because the soils in class V are subject to little or no erosion. They have other limitations that restrict their use to pasture, rangeland, woodland, wildlife habitat, or recreation.

Capability units are soil groups within a subclass. The soils in a capability unit are enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity. Capability units are generally designated by adding an Arabic numeral to the subclass symbol, for example, IIe-4 or IIIe-4.

The acreage of soils in each capability class and subclass is shown in table 7. The capability classification of the map units is given in the section "Detailed Soil Map Units," in the yields table, and under the heading "Interpretive Groups," which follows the tables at the back of this survey.

Rangeland

Kenneth L. Hladek, range conservationist, Natural Resources Conservation Service, helped prepare this section.

Rangeland makes up approximately 57 percent of the agricultural land in Keith County. It is in scattered areas throughout the county. The largest acreages, however, are in the sandhills in areas of the Valent association. Large cow-calf enterprises are typical in areas of this association. Major areas of rangeland also are in the Sully-Dix-Tassel and Sully-McConaughy associations. The livestock enterprises in these associations typically are smaller beef cattle units. They usually combine cash-grain and livestock operations. The rangeland throughout the county is primarily used for grazing by livestock, but about 12,000 acres is used for the production of native hay. Supplemental feed and crop residue for use by livestock are produced in some areas of cropland.

The raising of livestock, mainly cow-calf herds from which calves are sold in the fall as feeders, is one of the most important agricultural industries in the county. Cattle generally graze areas of range from late in the spring to early in the fall. Livestock graze the regrowth on native meadows and the corn residue on irrigated cropland in the fall. They are fed alfalfa and native hay during the winter and early spring. The forage produced on rangeland is supplemented with protein during the

fall and winter to meet the nutritional needs of the livestock.

Approximately 50 percent of the rangeland in Keith County produces less than half of its potential because it has been continuously overgrazed in the past. Poor grazing distribution and limited brush encroachment in areas of the Valent and Sully-Dix-Tassel associations have also reduced the production of forage.

The main goal of range management is excellent range condition. Proper management of range is the most important factor affecting the conservation of soil, water, and plants in the county. Proper range management and improvement practices, such as proper grazing use, planned grazing systems, range seeding, and brush control, increase the productivity of the range. Besides improving the yields of desirable forage plants, they reduce soil losses and increase the potential for producing livestock.

This section can aid ranchers and conservationists in planning the management of range. It defines range sites, explains the evaluation of range condition, and describes planned grazing systems and other aspects of range and hayland management.

In areas that have similar climate and topography, differences in the kind and amount of vegetation produced on rangeland are closely related to the kind of soil. Effective management is based on the relationship between the soils and vegetation and water.

Table 8 shows, for nearly all the soils, the range site; the total annual production of vegetation in favorable, normal, and unfavorable years; the characteristic vegetation; and the average percentage of each species. Only those soils that are used as rangeland or are suited to use as rangeland are listed. An explanation of the column headings in table 8 follows.

A *range site* is a distinctive kind of rangeland that produces a characteristic natural plant community that differs from natural plant communities on other range sites in kind, amount, and proportion of range plants. The relationship between soils and vegetation was ascertained during this survey; thus, range sites generally can be determined directly from the soil map. Soil properties that affect moisture supply and plant nutrients have the greatest influence on the productivity of range plants. Soil reaction, salt content, and a seasonal high water table are also important.

Total production is the amount of vegetation that can be expected to grow annually on well managed rangeland that is supporting the potential natural plant community. It includes all vegetation, whether or not it is palatable to grazing animals. It includes the current year's growth of leaves, twigs, and fruits of woody plants. It does not include the increase in stem diameter of trees and shrubs. It is expressed in pounds per acre of air-dry vegetation for favorable, normal, and unfavorable years. In a favorable year, the amount and distribution of precipitation and the temperatures make growing conditions substantially better than average. In a normal year, growing conditions are about average. In an unfavorable year, growing conditions are well below average, generally because of low available soil moisture.

Dry weight is the total annual yield per acre of air-dry vegetation. Yields are adjusted to a common percent of air-dry moisture content. The relationship of green weight to air-dry weight varies according to such factors as exposure, amount of shade, recent rains, and unseasonable dry periods.

Characteristic vegetation—the grasses, forbs, and shrubs that make up most of the potential natural plant community on each soil—is listed by common name. Under *composition*, the expected percentage of the total annual production is given for each species making up the characteristic vegetation. The amount that can be used as forage depends on the kinds of grazing animals and on the grazing season.

Range management requires a knowledge of the kinds of soil and of the potential natural plant community. It also requires an evaluation of the present range condition. Range condition is determined by comparing the present plant community with the potential natural plant community on a particular range site. The more closely the existing community resembles the potential community, the better the range condition. Range condition is an ecological rating only.

The objective in range management is to control grazing so that the plants growing on a site are about the same in kind and amount as the potential natural plant community for that site. Such management generally results in the optimum production of vegetation, control of undesirable brush species, conservation of water, and control of erosion. Sometimes, however, a range condition somewhat below the potential meets grazing needs, provides wildlife habitat, and protects soil and water resources.

Proper Grazing Use

Proper grazing use is grazing at an intensity that maintains sufficient plant cover to protect the soil and that maintains or improves both the quantity and quality of the desirable forage. It is the first and most important step in successful range management. It increases the vigor and reproductive capacity of desirable plants, leaves enough accumulated litter and mulch on the surface to help control erosion, and increases forage production. The proper intensity of grazing on rangeland during the entire growing season removes not more than half of the current year's growth, by weight.

Proper grazing use is determined by the degree to which desirable species are grazed in a key area. It is affected by stocking rates, distribution of livestock, and the kinds and classes of livestock.

The stocking rate is the number of grazing animals in a particular pasture. It is based on animal units and animal unit months. An *animal unit* is a measurement of livestock numbers based on the equivalent of one mature cow, weighing approximately 1,000 pounds, and a calf that is at least 4 months of age or the equivalent of the cow and calf. An *animal unit month* is the amount of forage or feed necessary to sustain an animal unit for 1 month. The range site and the range condition are used to determine animal unit months for each pasture. The suggested initial stocking rate for range sites in excellent condition is given for many of the soils under the heading "Detailed Soil Map Units." The rates are lower for range sites in less than excellent condition.

The suggested initial stocking rates for rangeland are relatively easy to calculate for any given soil or range site. For example, in an area of Valent fine sand, rolling, the suggested initial stocking rate is about 0.7 animal unit month per acre if the range is in excellent condition. Thus, a 640-acre pasture in excellent condition can carry about 448 animal units for 1 month. If the pasture is to be grazed for 5 months, then the suggested initial stocking rate would be about 90 animal units. The initial suggested stocking rate is based on the condition of the existing plant community and the average annual production of each range site. Because of weather conditions, forage production varies. The suggested rate is intended as an initial stocking rate and should be adjusted to changes in forage production or the management system.

The proper distribution of livestock throughout a pasture requires planning. Livestock tend to graze most heavily in areas near livestock watering facilities, in areas near roads or trails, and in gently sloping areas. Distant corners of pastures, steep terrain, and areas that are not near watering facilities are often undergrazed. Poor grazing distribution can result from too few watering facilities or from poorly distributed salting and watering facilities, shade, and supplemental feed. A continued concentration of livestock in one area results in severe overuse of that area and a hazard of erosion while the other areas are left underused. Carefully locating fences and salting and watering facilities and applying a planned grazing system help to achieve a uniform distribution of grazing (fig. 13).

Fences help to distribute grazing in a more uniform pattern. Also, they divide pastures into sections used in a planned grazing system and keep livestock out of blowouts and reseeded areas. Cross fences should be located so that they follow natural land features and range sites as much as possible. The potential stocking rate should be similar for all pastures. Generally, the smaller pastures are used more efficiently than the larger pastures. The efficiency in forage use should be considered in addition to the convenience in operation when the pasture size is determined.

Properly locating salt and mineral facilities is one of the easiest and most economical means of achieving a uniform distribution of grazing in a pasture. The salt and mineral facilities should be located away from water facilities. They can be easily moved to areas that are undergrazed and can be relocated at different times throughout the grazing season. On soils of the Valent association, relocating the salting station each time that salt is provided lessens the hazard of blowouts developing because of livestock concentrations.

Properly located watering facilities also can improve the distribution of grazing. In Keith County, livestock water is often obtained from wells that are pumped by windmills in areas of the Valent association. Dugouts are on the wetter range sites in areas of the Lex-Norwest-Alda association. Some stockwater dams are in areas of the Sully-Dix-Tassel association. Watering facilities should be spaced at varying distances, depending on the terrain. In rough or hilly areas, the distance between facilities should not be more than 0.5 mile. In the more level areas, it should be no more than 1.0 mile. If the distance is too far, the areas near water will be overgrazed.

Range management is also dependent on the kinds and classes of livestock grazing the pasture. Cattle, sheep, and horses have different grazing habits and nutritional needs that affect the way range can best be managed for proper grazing use. Cattle are the principal livestock raised in the county. They are well suited to grazing in areas of the major range sites. Grazing habits also differ among classes of cattle. Yearlings graze in more areas of a pasture than cows with calves. They also graze the steeper areas and will graze a pasture more uniformly than cows with calves. Their tendency to trail along fence lines can sometimes result in erosion. Cow-calf pairs generally graze more on the gentler slopes and stay closer to watering facilities than yearlings. As a result, poor grazing distribution may be more of a problem in pastures stocked with cows and calves than in those stocked with yearlings. Only a few horses and sheep are raised in the county.

General management techniques outlined in this section and in the "Detailed Soil Map Units" section apply principally to cattle production. Management techniques may need adjustment if other livestock are grazed.

Figure 13.—Livestock watering facilities in an area of Valent fine sand, 3 to 9 percent slopes.

Planned Grazing Systems

Planned grazing systems are effective in achieving maximum forage production and livestock performance while controlling erosion. In a planned grazing system, two or more pastures are alternately rested and grazed in a planned sequence over a period of years. The rest periods are planned for sometime during the growing season. All livestock should be removed from the pasture being rested. These pastures are grazed in a different sequence each year. By not grazing the same pasture at the same time each year, the plants are not close-cropped by livestock at the same stage of development every year. Planned grazing systems make it possible for plant vigor and forage production to increase and the plant community to improve, thus resulting in a better range condition. They permit maximum and uniform use of forage, while maintaining rangeland productivity.

Planned grazing systems can help to maintain or improve the plant cover and increase grazing efficiency by uniformly using all parts of a pasture. They also help to overcome the adverse effects of drought and other climatic changes.

To be effective, planned grazing systems must be flexible and adapted to the needs of an individual rancher. Fences, watering facilities, range condition, range sites, kinds or classes of grazing animals, and economic factors are all important considerations in determining the best system for a particular ranch. Grazing systems should be modified because of improved plant vigor, increased forage production, or changes in management needs.

Planned grazing systems can increase stocking rates through an increase in forage production and improved forage quality. They also minimize blowouts and reduce the number of parasites and the likelihood of diseases

among cattle since the pastures are usually cleaner than those continuously grazed.

Deferred Grazing

Deferred grazing is the resting of grazing land for a prescribed period. The need for deferment is based on the range condition and range trend. To be beneficial, deferment should be for a minimum of 3 consecutive months and should coincide with the critical growth periods of the desirable plants. This period varies, depending on the grass species. The maximum benefit from deferment coincides with the food storage period. For native warm-season grasses this period occurs from late July to early October. On some sites, a short deferment of 3 months is all that is needed, while on other sites a deferment of two complete growing seasons may be needed. Generally, some grazing throughout the year is more beneficial than a complete year long deferment. Following the period of deferment, the pasture can be grazed after the first heavy frost in the fall or early in the spring before the warm-season grasses begin to grow. If the pastures are grazed in winter, protein supplements are needed to meet the nutritional needs of the cattle.

Deferred grazing allows plants a rest period during critical times in their growth stages. This period allows grasses to become vigorous and to produce a mulch at the surface, thus increasing the rate of water infiltration. The mulch also reduces the susceptibility of the soil to erosion. Deferred grazing also promotes natural grass reseeding by allowing the desirable species to set seed and spread vegetatively.

Where severe overgrazing has eliminated the native grasses, the reseeding of range to adapted native grasses is the best method of restoration. Native range should be reseeded only after careful evaluation. In areas where the desirable plants remain, controlled grazing or a planned grazing system can restore the productivity of the range without reseeding.

Range Seeding

In some areas, such as formerly cultivated fields and abandoned farmsteads, range management alone cannot restore a satisfactory cover of native vegetation. Range seeding may be needed in these areas. It may also be needed in severely overgrazed areas where the vegetation has deteriorated so much that it will not respond to management practices.

Good stands of native grasses can be reestablished if the seedbed is properly prepared, adapted species of native grasses are selected for planting, the correct seeding methods are used, and careful management is applied after seeding.

Range seeding is most successful when the seedbed is firm and has a cover of mulch. A firm seedbed helps to ensure good soil-seed contact, which is essential for seedling development. The cover of mulch helps keep the soil moist, lowers the temperature of the surface soil, and helps to control erosion. It can be provided by planting a temporary crop, such as sudangrass or grain sorghum. The grass should be seeded directly into the stubble the following fall, winter, or spring. Tillage should be avoided because a firm seedbed is needed. On soils that have a coarse textured surface layer and are subject to soil blowing, such as those of the Valent association, preparing the seedbed and seeding in strips over a period of several years or planting the seeds with a range interseeder help to control soil blowing.

Seeding mixtures should consist of adapted native grasses that are on the site when it is in excellent range condition. Consequently, they vary according to the soils and range sites. Using a grassland drill with depth bands ensures the proper placement of seeds at a uniform depth. A range interseeder should be used in areas of soils in the Sands and Choppy Sands range sites and in areas that have a severe hazard of soil blowing. It places seeds in the center of a shallow furrow without disturbing the vegetation between the furrows.

Newly seeded areas should not be fully grazed until after the grass is well established. Establishment may take 2 or 3 years, depending on the grass species, the range site, the method of planting, and the weather. Initial grazing of these areas should be light. Limited grazing in early spring or in late fall and winter helps to control weeds until the grass is established. Proper grazing use and a planned grazing system help to keep the range productive after the grass is established.

Additional information about appropriate grass mixtures, grassland drills, and planting times can be obtained at the local office of the Natural Resources Conservation Service or the local office of the Natural Resources District.

Control of Blowouts

Blowouts form on sandy soils, mainly in areas of the Valent association, where the vegetation has been removed. Many blowouts form in areas of the sandhills that have been subject to continuous heavy grazing. Larger blowouts generally form in areas near wells where livestock tend to concentrate. Smaller blowouts often form along trails or fence lines. Drought increases the likelihood that blowouts will form.

Unless stabilized, blowouts are likely become larger. The wind blows sand to bordering areas, where the windblown sand smothers vegetation. The result is an expanding area that is subject to severe soil blowing.

A planned grazing system can stabilize many blowouts in 4 or 5 years. Locating salt and mineral facilities away from the blowouts helps to prevent the concentration of livestock in the area. A planned grazing system is the most effective way to minimize the formation of blowouts.

If a planned grazing system is not feasible, reseeding may be necessary. If blowouts are reseeded, steep banks around the edge of the blowouts should be reshaped into a stable slope. If a quick-growing cover crop is planted in the spring, an adapted native grass mixture can be drilled into the stubble from the crop. The cover crop helps to protect the surface from soil blowing, lowers the soil temperature, and creates a firm seedbed. If a cover crop is not practical, a mulch of native hay can be spread over the surface and worked into the sand after seeding. Mulching helps to prevent the damage caused by windblown sand while the grasses become established. Fencing blowout areas after seeding helps to keep out livestock until a desirable stand is established. Proper grazing use and a planned grazing system help to prevent reactivation of stabilized blowouts after the grasses are established.

Brush Control

Small soapweed, buckbrush, and sand sagebrush are the main brush species in the county. Although they are not a major range problem, these plants encroach on the land and reduce forage yields and carrying capacity.

Small soapweed and sand sagebrush are mainly a problem in areas of the Valent association. Small soapweed can generally be controlled by winter grazing. If it is grazed during the winter, it loses vigor and may be broken off below the root crown. Feeding cottonseed cake as a protein supplement increases the amount of small soapweed that cattle consume. Applications of an appropriate herbicide have had only limited effectiveness.

Sand sagebrush and buckbrush are best controlled by applications of an appropriate herbicide. Repeated applications for 2 consecutive years may be needed to control buckbrush. Areas treated with herbicide should be deferred from grazing to allow adequate recovery of grasses. Herbicide recommendations can be obtained from the Natural Resources Conservation Service or the county extension agent.

Management of Native Hayland

A limited amount of rangeland in the county is used for the production of native hay. Some hay is cut in areas of soils that have a high water table. These areas generally are in the Subirrigated range site in the Lex-Norwest-Alda association. Hay is harvested in a few upland areas that are generally used for grazing. The hayfields are in the Sandy Lowland, Sandy, or Sands range sites in the Valent association.

Proper management can maintain or improve the production of hay. Timely mowing is needed to maintain strong plant vigor and a high quality and quantity of forage. Mowing the grasses between the boot stage and the emergence of the seed heads allows for adequate regrowth and carbohydrate storage in the plant roots before the first frost. A mowing height of 3 inches or more helps to maintain plant vigor and promotes rapid regrowth.

Meadows should not be grazed or harvested for hay when the soil is wet or the water table is within a depth of 6 inches. Grazing or using heavy machinery at these times results in the formation of small bogs, ruts, and mounds which can hinder mowing in later years. Meadows can be grazed without damage after the ground is frozen, but livestock should be removed in spring before the ground thaws.

Hay grown in upland areas should be harvested only every other year. During the following year, grazing only in the fall or winter grazing allows the warm-season grasses to regain vigor and suppresses the cool-season grasses and weeds. As on wet sites, the best time for mowing is between the boot stage and the emergence of seed heads. Regulating mowing allows the desirable grasses to remain vigorous and healthy. Early mowing allows for good plant regrowth. The regrowth helps to hold snow on the surface and increases the supply of soil moisture.

Technical assistance in managing range and hayland can be obtained at the local office of the Natural Resources Conservation Service or at the local office of the Natural Resources District.

Range Condition

Range condition is the present state of the vegetation on a range site compared to the potential, or climax vegetation for that site. Climax vegetation is a stable plant community that represents the most productive combination of forage plants on a given range site and represents the highest potential in kind and amount of vegetation for a given range site. It reproduces itself and changes little as long as the climate and soil conditions remain unchanged.

Determining the range condition provides an approximate measure of the overall health of the plant community. More importantly, it provides a basis for predicting the degree of improvement possible under different kinds of management. Four condition classes

are used to indicate the departure from the potential, or climax vegetation. They are excellent, good, fair, and poor.

All food that plants use for maintenance, growth, and reproduction is manufactured in their leaves. Removal of plant leaves during the growing season affects the growth of both roots and shoots. Livestock graze selectively, removing more leaves from some plants than from others. This selective grazing varies according to the season and the kind and class of livestock. Because livestock graze selectively, various plants respond to continuous heavy grazing in different ways. Some decrease in abundance, some increase in abundance, and others not originally part of the plant community invade the range site. Plant responses to grazing are used in classifying the range condition.

The *decreaser species* are those species in the original plant community that decrease in abundance if grazed closely and continuously during the growing season. The *increaser species* are those species in the original plant community that increase in abundance under continuous heavy grazing as the decreaser plants become less abundant. The *invader species* are those species not in the original plant community that begin to grow on a site after the decreaser and increaser species have been weakened or eliminated. Once the range condition has been determined, it is important to know whether the range is improving or deteriorating in order to plan adjustments in grazing use and management. Important factors affecting trends in the plant community are the vigor and reproductive capacity of both desirable and undesirable species.

The goal of range management is excellent range condition. The highest forage yields are obtained on a sustained basis when the range is in excellent condition. In addition, soil blowing and water erosion are kept at an acceptable level without applying conservation practices and maximum use is made of precipitation by plants.

At the end of each description under the heading "Detailed Soil Map Units," the soil has been assigned to a range site. These classifications are based on the kind and amount of vegetation that can be expected when the site is in excellent condition.

Native Woodland

Keith A. Ticknor, forester, Natural Resources Conservation Service, helped prepare this section.

Approximately 1.4 percent, or 9,600 acres, in Keith County is forested. The woodland occurs as a gallery forest along the North Platte and South Platte Rivers in areas of the Gothenburg-Platte association. It is in the canyons and breaks of the Sully-Dix-Tassel association. Only a few scattered trees grow in the drainageways of uplands, generally in wet areas.

The Cottonwood-Willow forest cover type is in areas of the Platte River bottom land. This riparian forest depends on the availability of ground water along the river. It is maintained at less than the climax vegetation of a deciduous forest because of a semiarid environment and the lack of seed sources. The gradual increase in depth of the river channel in areas below Lake McConaughy has lowered the water table and caused many old cottonwood trees to die. Eastern cottonwood and peachleaf willow are the predominant species in areas of this forest cover type. Other species include sandbar willow, green ash, Russian-olive, golden currant, indigobush, and eastern redcedar.

The Eastern Redcedar forest cover type is in areas of steep, north- and east-facing slopes in the canyons and breaks. Eastern redcedar trees generally are lightly scattered on the slopes along with dense clumps of shrubs; however, thick stands of eastern redcedar trees are in some areas east of Lake McConaughy. Other shrubs are skunkbush sumac, American plum, common chokecherry, golden currant, silver buffaloberry, and western snowberry (white buckbrush).

Commercial use of the woodland is very limited because the wooded areas are not large; however, local use of the woodland is an important resource.

Windbreaks and Environmental Plantings

Keith A. Ticknor, forester, Natural Resources Conservation Service, helped prepare this section.

Windbreaks and environmental plantings have been planted at various times on most farmsteads and ranch headquarters in Keith County (fig. 14). Windbreaks that provide protection to livestock also are common, especially in the Lex-Norwest-Alda and Bayard-Duroc-Bridget associations. Siberian elm and eastern redcedar are the predominant species in most of the windbreaks and environmental plantings. Eastern cottonwood is frequently the predominant species in windbreaks on bottom land. Other species include green ash, honeylocust, boxelder, Russian mulberry, ponderosa pine, Austrian pine, Scotch pine, peachleaf willow, lilac, Siberian peashrub, and common chokecherry.

Planting trees and shrubs is a continual process because short-lived trees, such as Siberian elm, pass maturity and deteriorate; some trees are destroyed by insects, diseases, or storms; and new plantings are needed on expanding ranches. In areas where Siberian elm is the main species, supplemental plantings of evergreen trees and shrubs are needed to provide high-quality protection from the wind.

Very few field windbreaks or shelterbelts are in the

Figure 14.—A windbreak in an area of Satanta loam, 1 to 3 percent slopes.

county; however, windbreaks planted because of the Timber Claim Act of 1873 are in some areas and new field windbreaks are in the corners of fields irrigated by center-pivot systems. Most of the field windbreaks are in areas of the Lex-Norwest-Alda association.

The species of trees and shrubs grown as windbreaks should be those that are suited to the soils on the selected site. Permeability, available water capacity, fertility, soil depth, and soil texture greatly affect the growth rate of trees and shrubs. Selecting suitable species is the first step toward ensuring survival and a maximum growth rate.

Trees and shrubs are difficult to establish in the county because of a limited supply of moisture. Proper site preparation before planting and control of competing vegetation after planting are the major management objectives when establishing windbreaks. Cover crops may be needed to protect new plants from hot winds and windblown soil. Supplemental watering using drip irrigation systems or other irrigation systems can provide the moisture needed during establishment.

Windbreaks protect livestock, buildings, and yards from wind and snow. They also protect fruit trees and gardens, and they furnish habitat for wildlife. Several rows of low- and high-growing broadleaf and coniferous trees and shrubs provide the most protection.

Field windbreaks are narrow plantings made at right angles to the prevailing wind and at specific intervals across the field. The interval depends on the erodibility of the soil. Field windbreaks protect cropland and crops from wind, help to keep snow on the fields, and provide food and cover for wildlife.

Environmental plantings help to beautify and screen houses and other buildings and to abate noise. The

plants, mostly evergreen shrubs and trees, are closely spaced. To ensure plant survival, a healthy planting stock of suitable species should be planted properly on a well prepared site and maintained in good condition.

Table 9 shows the height that locally grown trees and shrubs are expected to reach in 20 years on various soils. The estimates in table 9 are based on measurements and observation of established plantings that have been given adequate care. They can be used as a guide in planning windbreaks and screens.

At the end of each description under the heading "Detailed Soil Map Units," the soil has been assigned to a windbreak suitability group. These groups are based primarily on the suitability of the soil for the locally adapted species, as is indicated by their growth and vigor. Detailed interpretations for each windbreak suitability group in the county are provided in the "Technical Guide," which is available in the local office of the Natural Resources Conservation Service.

Additional information on planning windbreaks and screens and planting and caring for trees and shrubs can be obtained from local offices of the Natural Resources Conservation Service or the Cooperative Extension Service or from a commercial nursery.

Recreation

Gerald E. Jasmer, wildlife biologist, Natural Resources Conservation Service, helped prepare this section.

Some of the finest recreational opportunities in Nebraska are in Keith County. Opportunities for picnicking, hiking, swimming, fishing, hunting, water skiing, boating, sailing, canoeing, and camping are plentiful. Many natural, scenic, and historical sites are available for sightseeing.

Several famous trails that settlers used to travel west are in Keith County. The Mormon National Historic Trail led travelers west along the North Platte River. The Oregon National Historic Trail followed the South Platte River west to a point near Ogallala and then angled north to the North Platte River. Other trails in the county include the Texas Trail, the California Trail, and the Overland Trail. The Nebraska State Historical Society in Lincoln has additional information about the history of Keith County.

Most of the recreational activities in the county center around Lake McConaughy and Lake Ogallala. Lake McConaughy is Nebraska's biggest reservoir. It is more than 35,000 surface acres in size. It was completed in 1941. Lake Ogallala was formed by the borrow pit for the Kingsley Dam.

The Lake McConaughy State Recreation Area and Lake Ogallala State Recreation Area provide many recreational facilities. Boat ramps, camping sites, picnic shelters, drinking water, restrooms, showers, dump stations, electrical hookups, snowmobile trails, and playgrounds are available. Hunting of waterfowl and upland game is allowed during regular hunting seasons.

The Nebraska Game and Parks Commission provides hunting blinds and decoys for waterfowl hunters at the Clear Creek Waterfowl Management Area at the west end of Lake McConaughy. Canada geese are the most common species hunted.

The Ogallala Strip Wildlife Management Area is along the South Platte River near Ogallala. This 465-acre area is a good location for hunting, hiking, and canoeing.

Walleye, white bass, smallmouth bass, channel catfish, and rainbow trout can be caught in Lake McConaughy. In the early 1970's, fishing for striped bass became very popular. Stocking of striped bass ceased in 1978 because of changes in management objectives and lake conditions. Lake Ogallala receives cold tailwater from the lower levels of Lake McConaughy and is best known for trout. Rainbow trout is the most common species caught in Lake Ogallala, but cutthroat trout, walleye, white bass, and channel catfish also are caught.

The Central Nebraska Public Power and Irrigation District Canal originates at the Keystone Diversion Dam just below Lake Ogallala. The canal produces large rainbow trout and brown trout. Trout also can be found in the North Platte River east of the Keystone Diversion Dam. Several small cold water streams enter Lake McConaughy and the North Platte River from the north. Whitetail Creek supports limited numbers of brown trout. Rainbow trout are in Otter Creek, Clear Creek, and Lonergan Creek. These streams are primarily on private land.

The South Platte River provides few opportunities for recreational fishing; however, channel catfish are sometimes caught. Some of the few privately owned sand and gravel pits in the county provide excellent fishing opportunities for largemouth bass, bluegill, and crappie. Permission of the landowners must be obtained prior to fishing on private land.

Hunting for big game, small game, and waterfowl is popular in Keith County. Big game species that are hunted include whitetail deer, mule deer, pronghorn antelope, and wild turkey. The major small game species that are hunted are prairie chickens, ring-necked pheasant, bobwhite quail, cottontail rabbit, coyote, raccoon, and fox squirrel. Mourning dove are common throughout the county and are hunted in early fall. The waterfowl hunted includes numerous species of ducks and geese. Hunting for Canada geese is especially popular. Hunting takes place during regular seasons in public areas open to hunting and on private

land. Hunting on private land is by permission of the landowner.

Several private businesses in the county charge a fee for recreational activities, including fishing, waterfowl and upland game hunting, scuba diving, windsurfing, sailboating, and camping. Additional information about these activities can be obtained from the Keith County Chamber of Commerce and Tourism Bureau in Ogallala.

Additional information on improving fish and wildlife habitat and designing recreational facilities can be obtained from local offices of the Natural Resources Conservation Service.

The soils of the survey area are rated in table 10 according to limitations that affect their suitability for recreation. The ratings are based on restrictive soil features, such as wetness, slope, and texture of the surface layer. Susceptibility to flooding is considered. Not considered in the ratings, but important in evaluating a site, are the location and accessibility of the area, the size and shape of the area and its scenic quality, vegetation, access to water, potential water impoundment sites, and access to public sewer lines. The capacity of the soil to absorb septic tank effluent and the ability of the soil to support vegetation are also important. Soils subject to flooding are limited for recreational uses by the duration and intensity of flooding and the season when flooding occurs. In planning recreational facilities, onsite assessment of the height, duration, intensity, and frequency of flooding is essential.

In table 10, the degree of soil limitation is expressed as slight, moderate, or severe. *Slight* means that soil properties are generally favorable and that limitations are minor and easily overcome. *Moderate* means that limitations can be overcome or alleviated by planning, design, or special maintenance. *Severe* means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, limited use, or by a combination of these measures.

The information in table 10 can be supplemented by other information in this survey, for example, interpretations for septic tank absorption fields in table 13 and interpretations for dwellings without basements and for local roads and streets in table 12.

Camp areas require site preparation, such as shaping and leveling the tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. The best soils are gently sloping and are not wet or subject to flooding during the period of use. The surface has few or no stones or boulders, absorbs rainfall readily but remains firm, and is not dusty when dry. Strong slopes and stones or boulders can greatly increase the cost of constructing campsites.

Picnic areas are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The best soils for picnic areas are firm when wet, are not dusty when dry, are not subject to flooding during the period of use, and do not have slopes or stones or boulders that increase the cost of shaping sites or of building access roads and parking areas.

Playgrounds require soils that can withstand intensive foot traffic. The best soils are almost level and are not wet or subject to flooding during the season of use. The surface is free of stones and boulders, is firm after rains, and is not dusty when dry. If grading is needed, the depth of the soil over bedrock or a hardpan should be considered.

Paths and trails for hiking and horseback riding should require little or no cutting and filling. The best soils are not wet, are firm after rains, are not dusty when dry, and are not subject to flooding more than once a year during the period of use. They have moderate slopes and few or no stones or boulders on the surface.

Wildlife Habitat

Gerald E. Jasmer, wildlife biologist, Natural Resources Conservation Service, helped prepare this section.

Keith County has a wide variety of wildlife habitat types for openland, wetland, woodland, and rangeland species. The kind and abundance of wildlife depend largely on the amount and distribution of food, cover, and water. The kind and amount of vegetation that is available to wildlife as food and cover, the availability of natural water sources, and the potential for construction of water impoundments are affected by the soils.

The Central High Tableland and the Nebraska Sand Hills major land resources areas often have different potential for wildlife production. The associations in the county can be grouped according to the wildlife habitat and wildlife species they support. Each association's relationship to wildlife habitat is discussed in the following paragraphs.

The Valent and Janise-Boel-Lawet associations make up the majority of the Nebraska Sand Hills major land resource area. This sandy area is north of the North Platte River.

The Valent association is almost entirely rangeland that is used for grazing. The plants which make up high-quality rangeland habitat consist of native grasses and forbs and scattered woody plants. Wildlife species that are typically found in areas of this association are prairie chickens, coyote, mule deer, jackrabbits, small

rodents, meadowlark, horned lark, and pronghorn antelope.

The Janise-Boel-Lawet association consists of sandy soils that have a high water table and that are commonly alkaline. It is predominantly rangeland that is used for the production of native hay and for the grazing of livestock. Some alfalfa is grown. The scarcity of grain crops may somewhat limit wildlife production. The kinds of wildlife in areas of this association are similar to those in areas of the Valent association. The creation of wetland areas could dramatically increase the kind and number of wildlife.

The Central High Tableland major land resource area has more diverse associations and wildlife habitat than the Nebraska Sand Hills major land resource area. Many of the associations in the Central High Tableland area have similar potential for wildlife habitat and can be grouped together.

The Sarben-Vetal, Satanta-Dix-Altvan, Kuma-Duroc-Keith, and Satanta-Kuma associations consist of areas of dry cropland, irrigated cropland, pasture, hayland, and shallow wetlands. The primary crops are winter wheat, irrigated corn, and alfalfa. These associations provide habitat for a variety of openland wildlife, such as pheasants, cottontail rabbits, and mourning dove. Potholes provide feeding and resting areas for migrating waterfowl and shore birds in the spring. A lack of undisturbed nesting areas, permanent water, and winter cover, such as field shelterbelts and farmstead shelterbelts, are limitations affecting wildlife habitat.

The Bayard-Duroc-Bridget and Lex-Norwest-Alda associations are similar to the Sarben-Vetal, Satanta-Dix-Altvan, Kuma-Duroc-Keith, and Satanta-Kuma associations; however, more areas are used for the production of irrigated corn. They form narrow bands along the North Platte River and South Platte River valleys. These areas support good numbers of openland wildlife. Irrigation canals and their adjacent grassy borders, the nearby rivers, and farmstead shelterbelts provide food, cover, and water for wildlife.

The Gothenburg-Platte association is in areas along the North Platte and South Platte Rivers and on low bottom land. The permanent water supply and the dense cover of shrubs and trees on river banks and islands provide excellent habitat throughout the year. Species of plants commonly found in the area include chokecherry, American plum, indigobush, wild grape, cottonwood, and willow. Waterfowl, herons, shorebirds, mink, raccoon, coyote, bobcat, wild turkey, songbirds, whitetail deer, cottontail rabbit, great horned owl, and small rodents are common species of wildlife. Areas of the Gothenburg-Platte association provide important seasonal habitat to several species of wildlife on the Federal endangered species list. These species include the bald eagle, least tern, piping plover, and whooping crane. The river otter, which inhabits areas of the Gothenburg-Pike association throughout the year, is on the State list of endangered species.

Areas of the Sully-Dix-Tassel and Sully-McConaughy associations make up much of the land between the North Platte and South Platte Rivers. Areas of range and cropland that are used for the production of winter wheat are predominant. Mule deer, coyote, and prairie chickens are common species of wildlife. Field shelterbelts in areas of the cropland can provide winter cover for wildlife and help to control soil blowing.

Soils affect the kind and amount of vegetation that is available to wildlife as food and cover. They also affect the construction of water impoundments. The kind and abundance of wildlife depend largely on the amount and distribution of food, cover, and water. Wildlife habitat can be created or improved by planting appropriate vegetation, by maintaining the existing plant cover, or by promoting the natural establishment of desirable plants.

In table 11, the soils in the survey area are rated according to their potential for providing habitat for various kinds of wildlife. This information can be used in planning parks, wildlife refuges, nature study areas, and other developments for wildlife; in selecting soils that are suitable for establishing, improving, or maintaining specific elements of wildlife habitat; and in determining the intensity of management needed for each element of the habitat.

The potential of the soil is rated good, fair, poor, or very poor. A rating of *good* indicates that the element or kind of habitat is easily established, improved, or maintained. Few or no limitations affect management, and satisfactory results can be expected. A rating of *fair* indicates that the element or kind of habitat can be established, improved, or maintained in most places. Moderately intensive management is required for satisfactory results. A rating of *poor* indicates that limitations are severe for the designated element or kind of habitat. Habitat can be created, improved, or maintained in most places, but management is difficult and must be intensive. A rating of *very poor* indicates that restrictions for the element or kind of habitat are very severe and that unsatisfactory results can be expected. Creating, improving, or maintaining habitat is impractical or impossible.

The elements of wildlife habitat are described in the following paragraphs.

Grain and seed crops are domestic grains and seed-producing herbaceous plants. Soil properties and features that affect the growth of grain and seed crops are depth of the root zone, texture of the surface layer, available water capacity, wetness, slope, surface

stoniness, and flooding. Soil temperature and soil moisture are also considerations. Examples of grain and seed crops are corn, wheat, oats, millet, and grain sorghum.

Grasses and legumes are domestic perennial grasses and herbaceous legumes. Soil properties and features that affect the growth of grasses and legumes are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, flooding, and slope. Soil temperature and soil moisture are also considerations. Examples of grasses and legumes are smooth brome, intermediate wheatgrass, clover, and alfalfa.

Wild herbaceous plants are native or naturally established grasses and forbs, including weeds. Soil properties and features that affect the growth of these plants are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, and flooding. Soil temperature and soil moisture are also considerations. Examples of wild herbaceous plants are big bluestem, little bluestem, switchgrass, goldenrod, sideoats grama, sunflower, and ragweed.

Hardwood trees and woody understory produce nuts or other fruit, buds, catkins, twigs, bark, and foliage. Soil properties and features that affect the growth of hardwood trees and shrubs are depth of the root zone, available water capacity, and wetness. Examples of these plants are green ash, honeylocust, hackberry, cottonwood, willow, and Siberian elm.

Coniferous plants furnish browse and seeds. Soil properties and features that affect the growth of coniferous trees, shrubs, and ground cover are depth of the root zone, available water capacity, and wetness. Examples of coniferous plants are pine, spruce, fir, cedar, and juniper.

Shrubs are bushy woody plants that produce fruit, buds, twigs, bark, and foliage. Soil properties and features that affect the growth of shrubs are depth of the root zone, available water capacity, salinity, and soil moisture. Examples of shrubs are American plum, skunkbush sumac, chokecherry, silver buffaloberry, cotoneaster, and crabapple.

Wetland plants are annual and perennial wild herbaceous plants that grow on moist or wet sites. Submerged or floating aquatic plants are excluded. Soil properties and features affecting wetland plants are texture of the surface layer, wetness, reaction, salinity, slope, and surface stoniness. Examples of wetland plants are smartweed, prairie cordgrass, bulrushes, cattails, sedges, and reeds.

Shallow water areas have an average depth of less than 5 feet. Some are naturally wet areas. Others are created by dams, levees, or other water-control structures. Soil properties and features affecting shallow water areas are depth to bedrock, wetness, surface stoniness, slope, and permeability. Examples of shallow water areas are marshes, waterfowl feeding areas, and ponds.

The habitat for various kinds of wildlife is described in the following paragraphs.

Habitat for openland wildlife consists of cropland, pasture, meadows, and areas that are overgrown with grasses, herbs, shrubs, and vines. These areas produce grain and seed crops, grasses and legumes, and wild herbaceous plants. Wildlife attracted to these areas include jackrabbit, mourning dove, badger, skunk, pheasant, meadowlark, field sparrow, killdeer, harvest mice, and grasshopper sparrow.

Habitat for woodland wildlife consists of areas of deciduous plants or coniferous plants or both and associated grasses, legumes, and wild herbaceous plants. Wildlife attracted to these areas include wild turkey, porcupine, woodpeckers, fox squirrels, raccoon, deer, and songbirds.

Habitat for wetland wildlife consists of open, marshy or swampy shallow water areas. Some of the wildlife attracted to such areas are ducks, geese, herons, shore birds, marsh wrens, painted turtle, muskrat, mink, and beaver.

Habitat for rangeland wildlife consists of areas of shrubs and wild herbaceous plants. Wildlife attracted to rangeland include pronghorn antelope, mule deer, coyote, prairie dog, meadowlark, bullsnake, upland sandpiper, box turtle, pocket mice, and greater prairie chicken.

Engineering

This section provides information for planning land uses related to urban development and to water management. Soils are rated for various uses, and the most limiting features are identified. Ratings are given for building site development, sanitary facilities, construction materials, and water management. The ratings are based on observed performance of the soils and on the estimated data and test data in the "Soil Properties" section.

Information in this section is intended for land use planning, for evaluating land use alternatives, and for planning site investigations prior to design and construction. The information, however, has limitations. For example, estimates and other data generally apply only to that part of the soil within a depth of 5 or 6 feet. Because of the map scale, small areas of different soils may be included within the mapped areas of a specific soil.

The information is not site specific and does not

eliminate the need for onsite investigation of the soils or for testing and analysis by personnel experienced in the design and construction of engineering works.

Government ordinances and regulations that restrict certain land uses or impose specific design criteria were not considered in preparing the information in this section. Local ordinances and regulations should be considered in planning, in site selection, and in design.

Soil properties, site features, and observed performance were considered in determining the ratings in this section. During the fieldwork for this soil survey, determinations were made about grain-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of bedrock within 5 or 6 feet of the surface, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure aggregation, and soil density. Data were collected about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kinds of adsorbed cations. Estimates were made for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, and other behavioral characteristics affecting engineering uses.

This information can be used to evaluate the potential of areas for residential, commercial, industrial, and recreational uses; make preliminary estimates of construction conditions; evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; evaluate alternative sites for sanitary landfills, septic tank absorption fields, and sewage lagoons; plan detailed onsite investigations of soils and geology; locate potential sources of gravel, sand, earthfill, and topsoil; plan drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; and predict performance of proposed small structures and pavements by comparing the performance of existing similar structures on the same or similar soils.

The information in the tables, along with the soil maps, the soil descriptions, and other data provided in this survey, can be used to make additional interpretations.

Some of the terms used in this soil survey have a special meaning in soil science and are defined in the "Glossary."

Building Site Development

Table 12 shows the degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, local roads and streets, and lawns and landscaping. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required. Special feasibility studies may be required where the soil limitations are severe.

Shallow excavations are trenches or holes dug to a maximum depth of 5 or 6 feet for basements, graves, utility lines, open ditches, and other purposes. The ratings are based on soil properties, site features, and observed performance of the soils. The ease of digging, filling, and compacting is affected by the depth to bedrock, a cemented pan, or a very firm dense layer; stone content; soil texture; and slope. The time of the year that excavations can be made is affected by the depth to a seasonal high water table and the susceptibility of the soil to flooding. The resistance of the excavation walls or banks to sloughing or caving is affected by soil texture and depth to the water table.

Dwellings and *small commercial buildings* are structures built on shallow foundations on undisturbed soil. The load limit is the same as that for single-family dwellings no higher than three stories. Ratings are made for small commercial buildings without basements, for dwellings with basements, and for dwellings without basements. The ratings are based on soil properties, site features, and observed performance of the soils. A high water table, flooding, shrinking and swelling, and organic layers can cause the movement of footings. A high water table, depth to bedrock or to a cemented pan, large stones, slope, and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 or 6 feet are not considered.

Local roads and streets have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material; a base of gravel, crushed rock, or stabilized soil material; and a flexible or rigid surface. Cuts and fills are generally limited to less than 6 feet. The ratings are based on soil properties, site features, and observed performance of the soils. Depth to bedrock or to a cemented pan, a high water table, flooding, large stones, and slope affect the ease of excavating and grading. Soil strength (as inferred from the engineering classification of the soil), shrink-swell potential, frost action potential, and depth to a high water table affect the traffic-supporting capacity.

Lawns and landscaping require soils on which turf and ornamental trees and shrubs can be established and maintained. The ratings are based on soil

properties, site features, and observed performance of the soils. Soil reaction, a high water table, depth to bedrock or to a cemented pan, the available water capacity in the upper 40 inches, and the content of salts, sodium, and sulfidic materials affect plant growth. Flooding, wetness, slope, stoniness, and the amount of sand, clay, or organic matter in the surface layer affect trafficability after vegetation is established.

Sanitary Facilities

Table 13 shows the degree and kind of soil limitations that affect septic tank absorption fields, sewage lagoons, and sanitary landfills. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required.

Table 13 also shows the suitability of the soils for use as daily cover for landfill. A rating of *good* indicates that soil properties and site features are favorable for the use and good performance and low maintenance can be expected; *fair* indicates that soil properties and site features are moderately favorable for the use and one or more soil properties or site features make the soil less desirable than the soils rated good; and *poor* indicates that one or more soil properties or site features are unfavorable for the use and overcoming the unfavorable properties requires special design, extra maintenance, or costly alteration.

Septic tank absorption fields are areas in which effluent from a septic tank is distributed into the soil through subsurface tiles or perforated pipe. Only that part of the soil between depths of 24 and 72 inches is evaluated. The ratings are based on soil properties, site features, and observed performance of the soils. Permeability, a high water table, depth to bedrock or to a cemented pan, and flooding affect absorption of the effluent. Large stones and bedrock or a cemented pan interfere with installation.

Unsatisfactory performance of septic tank absorption fields, including excessively slow absorption of effluent, surfacing of effluent, and hillside seepage, can affect public health. Ground water can be polluted if highly permeable sand and gravel or fractured bedrock is less than 4 feet below the base of the absorption field, if slope is excessive, or if the water table is near the surface. There must be unsaturated soil material beneath the absorption field to filter the effluent effectively. Many local ordinances require that this material be of a certain thickness.

Sewage lagoons are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons should have a nearly level floor surrounded by cut slopes or embankments of compacted soil. Lagoons generally are designed to hold the sewage within a depth of 2 to 5 feet. Nearly impervious soil material for the lagoon floor and sides is required to minimize seepage and contamination of ground water.

Table 13 gives ratings for the natural soil that makes up the lagoon floor. The surface layer and, generally, 1 or 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features, and observed performance of the soils. Considered in the ratings are slope, permeability, a high water table, depth to bedrock or to a cemented pan, flooding, large stones, and content of organic matter.

Excessive seepage resulting from rapid permeability in the soil or a water table that is high enough to raise the level of sewage in the lagoon causes a lagoon to function unsatisfactorily. Pollution results if seepage is excessive or if floodwater overtops the lagoon. A high content of organic matter is detrimental to proper functioning of the lagoon because it inhibits aerobic activity. Slope, bedrock, and cemented pans can cause construction problems, and large stones can hinder compaction of the lagoon floor.

Sanitary landfills are areas where solid waste is disposed of by burying it in soil. There are two types of landfill—trench and area. In a trench landfill, the waste is placed in a trench. It is spread, compacted, and covered daily with a thin layer of soil excavated at the site. In an area landfill, the waste is placed in successive layers on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil from a source away from the site.

Both types of landfill must be able to bear heavy vehicular traffic. Both types involve a risk of ground-water pollution. Ease of excavation and revegetation should be considered.

The ratings in table 13 are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock or to a cemented pan, a high water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, highly organic layers, soil reaction, and content of salts and sodium affect trench landfills. Unless otherwise stated, the ratings apply only to that part of the soil within a depth

of about 6 feet. For deeper trenches, a limitation rated slight or moderate may not be valid. Onsite investigation is needed.

Daily cover for landfill is the soil material that is used to cover compacted solid waste in an area sanitary landfill. The soil material is obtained offsite, transported to the landfill, and spread over the waste.

Soil texture, wetness, coarse fragments, and slope affect the ease of removing and spreading the material during wet and dry periods. Loamy or silty soils that are free of large stones or excess gravel are the best cover for a landfill. Clayey soils are sticky or cloddy and are difficult to spread; sandy soils are subject to soil blowing.

After soil material has been removed, the soil material remaining in the borrow area must be thick enough over bedrock, a cemented pan, or the water table to permit revegetation. The soil material used as final cover for a landfill should be suitable for plants. The surface layer generally has the best workability, more organic matter, and the best potential for plants. Material from the surface layer should be stockpiled for use as the final cover.

Construction Materials

Table 14 gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated *good, fair,* or *poor* as a source of roadfill and topsoil. They are rated as a *probable* or *improbable* source of sand and gravel. The ratings are based on soil properties and site features that affect the removal of the soil and its use as construction material. Normal compaction, minor processing, and other standard construction practices are assumed. Each soil is evaluated to a depth of 5 or 6 feet.

Roadfill is soil material that is excavated in one place and used in road embankments in another place. In this table, the soils are rated as a source of roadfill for low embankments, generally less than 6 feet high and less exacting in design than higher embankments.

The ratings are for the soil material below the surface layer to a depth of 5 or 6 feet. It is assumed that soil layers will be mixed during excavating and spreading. Many soils have layers of contrasting suitability within their profile. The table showing engineering index properties provides detailed information about each soil layer. This information can help to determine the suitability of each layer for use as roadfill. The performance of soil after it is stabilized with lime or cement is not considered in the ratings.

The ratings are based on soil properties, site features, and observed performance of the soils. The thickness of suitable material is a major consideration. The ease of excavation is affected by large stones, a high water table, and slope. How well the soil performs in place after it has been compacted and drained is determined by its strength (as inferred from the engineering classification of the soil) and shrink-swell potential.

Soils rated *good* contain significant amounts of sand or gravel or both. They have at least 5 feet of suitable material, a low shrink-swell potential, few cobbles and stones, and slopes of 15 percent or less. Depth to the water table is more than 3 feet. Soils rated *fair* are more than 35 percent silt- and clay-sized particles and have a plasticity index of less than 10. They have a moderate shrink-swell potential, slopes of 15 to 25 percent, or many stones. Depth to the water table is 1 to 3 feet. Soils rated *poor* have a plasticity index of more than 10, a high shrink-swell potential, many stones, or slopes of more than 25 percent. They are wet and have a water table at a depth of less than 1 foot. They may have layers of suitable material, but the material is less than 3 feet thick.

Sand and gravel are natural aggregates suitable for commercial use with a minimum of processing. They are used in many kinds of construction. Specifications for each use vary widely. In table 14, only the probability of finding material in suitable quantity is evaluated. The suitability of the material for specific purposes is not evaluated, nor are factors that affect excavation of the material.

The properties used to evaluate the soil as a source of sand or gravel are gradation of grain sizes (as indicated by the engineering classification of the soil), the thickness of suitable material, and the content of rock fragments. Kinds of rock, acidity, and stratification are given in the soil series descriptions. Gradation of grain sizes is given in the table on engineering index properties.

A soil rated as a probable source has a layer of clean sand or gravel or a layer of sand or gravel that is up to 12 percent silty fines. This material must be at least 3 feet thick and less than 50 percent, by weight, large stones. All other soils are rated as an improbable source. Coarse fragments of soft bedrock, such as shale and siltstone, are not considered to be sand and gravel.

Topsoil is used to cover an area so that vegetation can be established and maintained. The upper 40 inches of a soil is evaluated for use as topsoil. Also evaluated is the reclamation potential of the borrow area.

Plant growth is affected by toxic material and by such properties as soil reaction, available water capacity, and fertility. The ease of excavating, loading, and spreading is affected by rock fragments, slope, a water table, soil texture, and thickness of suitable material. Reclamation

of the borrow area is affected by slope, a water table, rock fragments, bedrock, and toxic material.

Soils rated *good* have friable, loamy material to a depth of at least 40 inches. They are free of stones and cobbles, have little or no gravel, and have slopes of less than 8 percent. They are low in content of soluble salts, are naturally fertile or respond well to fertilizer, and are not so wet that excavation is difficult.

Soils rated *fair* are sandy soils, loamy soils that have a relatively high content of clay, soils that have only 20 to 40 inches of suitable material, soils that have an appreciable amount of gravel, stones, or soluble salts, or soils that have slopes of 8 to 15 percent. The soils are not so wet that excavation is difficult.

Soils rated *poor* are very sandy or clayey, have less than 20 inches of suitable material, have a large amount of gravel, stones, or soluble salts, have slopes of more than 15 percent, or have a seasonal high water table at or near the surface.

The surface layer of most soils is generally preferred for topsoil because of its organic matter content. Organic matter greatly increases the absorption and retention of moisture and nutrients for plant growth.

Water Management

Table 15 gives information on the soil properties and site features that affect water management. The degree and kind of soil limitations are given for pond reservoir areas; embankments, dikes, and levees; and aquifer-fed excavated ponds. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and are easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increase in construction costs, and possibly increased maintenance are required.

This table also gives for each soil the restrictive features that affect drainage, irrigation, terraces and diversions, and grassed waterways.

Pond reservoir areas hold water behind a dam or embankment. Soils best suited to this use have low seepage potential in the upper 60 inches. The seepage potential is determined by the permeability of the soil and the depth to fractured bedrock or other permeable material. Excessive slope can affect the storage capacity of the reservoir area.

Embankments, dikes, and levees are raised structures of soil material, generally less than 20 feet high, constructed to impound water or to protect land against overflow. In this table, the soils are rated as a source of material for embankment fill. The ratings apply to the soil material below the surface layer to a depth of about 5 feet. It is assumed that soil layers will be uniformly mixed and compacted during construction.

The ratings do not indicate the ability of the natural soil to support an embankment. Soil properties to a depth even greater than the height of the embankment can affect performance and safety of the embankment. Generally, deeper onsite investigation is needed to determine these properties.

Soil material in embankments must be resistant to seepage, piping, and erosion and have favorable compaction characteristics. Unfavorable features include less than 5 feet of suitable material and a high content of stones or boulders, organic matter, or salts or sodium. A high water table affects the amount of usable material. It also affects trafficability.

Aquifer-fed excavated ponds are pits or dugouts that extend to a ground-water aquifer or to a depth below a permanent water table. Excluded are ponds that are fed only by surface runoff and embankment ponds that impound water 3 feet or more above the original surface. Excavated ponds are affected by depth to a permanent water table, permeability of the aquifer, and quality of the water as inferred from the salinity of the soil. Depth to bedrock and the content of large stones affect the ease of excavation.

Drainage is the removal of excess surface and subsurface water from the soil. How easily and effectively the soil is drained depends on the depth to bedrock, to a cemented pan, or to other layers that affect the rate of water movement; permeability; depth to a high water table or depth of standing water if the soil is subject to ponding; slope; susceptibility to flooding; subsidence of organic layers; and the potential for frost action. Excavating and grading and the stability of ditchbanks are affected by depth to bedrock or to a cemented pan, large stones, slope, and the hazard of cutbanks caving. The productivity of the soil after drainage is adversely affected by extreme acidity or by toxic substances in the root zone, such as salts, sodium, or sulfur. Availability of drainage outlets is not considered in the ratings.

Irrigation is the controlled application of water to supplement rainfall and support plant growth. The design and management of an irrigation system are affected by depth to the water table, the need for drainage, flooding, available water capacity, intake rate, permeability, erosion hazard, and slope. The construction of a system is affected by large stones and depth to bedrock or to a cemented pan. The performance of a system is affected by the depth of the root zone, the amount of salts or sodium, and soil reaction.

Terraces and diversions are embankments or a combination of channels and ridges constructed across a slope to control erosion and conserve moisture by intercepting runoff. Slope, wetness, large stones, and depth to bedrock or to a cemented pan affect the construction of terraces and diversions. A restricted rooting depth, a severe hazard of soil blowing or water erosion, an excessively coarse texture, and restricted permeability adversely affect maintenance.

Grassed waterways are natural or constructed channels, generally broad and shallow, that conduct surface water to outlets at a nonerosive velocity. Large stones, wetness, slope, and depth to bedrock or to a cemented pan affect the construction of grassed waterways. A hazard of soil blowing, low available water capacity, restricted rooting depth, toxic substances such as salts or sodium, and restricted permeability adversely affect the growth and maintenance of the grass after construction.

Soil Properties

Data relating to soil properties are collected during the course of the soil survey. The data and the estimates of soil and water features, listed in tables, are explained on the following pages.

Soil properties are determined by field examination of the soils and by laboratory index testing of some benchmark soils. Established standard procedures are followed. During the survey, many shallow borings are made and examined to identify and classify the soils and to delineate them on the soil maps. Samples are taken from some typical profiles and tested in the laboratory to determine grain-size distribution, plasticity, and compaction characteristics. These results are reported in table 19.

Estimates of soil properties are based on field examinations, on laboratory tests of samples from the survey area, and on laboratory tests of samples of similar soils in nearby areas. Tests verify field observations, verify properties that cannot be estimated accurately by field observation, and help to characterize key soils.

The estimates of soil properties shown in the tables include the range of grain-size distribution and Atterberg limits, the engineering classification, and the physical and chemical properties of the major layers of each soil. Pertinent soil and water features also are given.

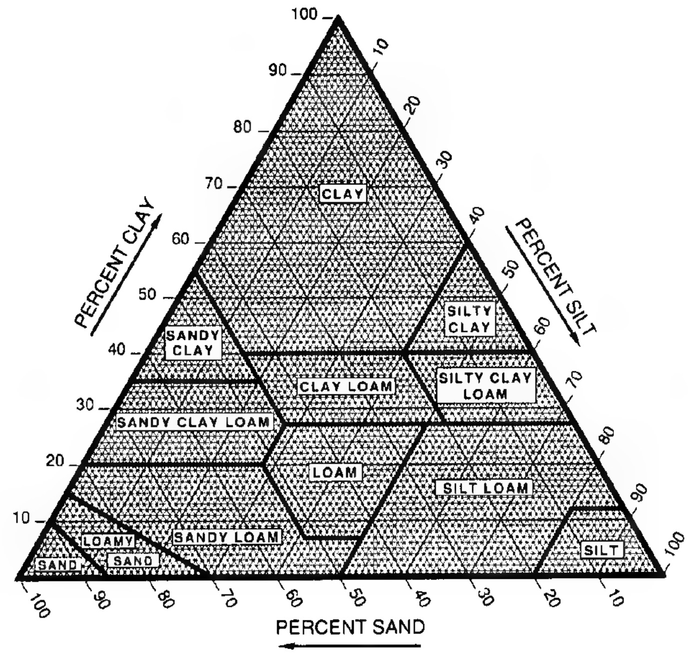

Figure 15.—Percentages of clay, silt, and sand in the basic USDA textural classes.

Engineering Index Properties

Table 16 gives estimates of the engineering classification and of the range of index properties for the major layers of each soil in the survey area. Most soils have layers of contrasting properties within the upper 5 or 6 feet.

Depth to the upper and lower boundaries of each layer is indicated. The range in depth and information on other properties of each layer are given for each soil series under the heading "Soil Series and Their Morphology."

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter (fig. 15). "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the content of particles coarser than sand is as much as about 15 percent, an appropriate modifier is added, for example, "gravelly." Textural terms are defined in the "Glossary."

Classification of the soils is determined according to the Unified soil classification system *(2)* and the system adopted by the American Association of State Highway and Transportation Officials *(1)*.

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and

clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as PT. Soils exhibiting engineering properties of two groups can have a dual classification, for example, CL-ML.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, or A-7-6. As an additional refinement, the suitability of a soil as subgrade material can be indicated by a group index number. In Nebraska, the group index numbers range from -4 for the best subgrade material to 32 for the poorest. The AASHTO classification for soils tested, with group index numbers in parentheses, is given in table 19.

Rock fragments 3 to 10 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage.

Percentage (of soil particles) passing designated sieves is the percentage of the soil fraction less than 3 inches in diameter based on an ovendry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field.

Liquid limit and *plasticity index* (Atterberg limits) indicate the plasticity characteristics of a soil. The estimates are based on test data from the survey area or from nearby areas and on field examination.

The estimates of grain-size distribution, liquid limit, and plasticity index are generally rounded to the nearest 5 percent. Thus, if the ranges of gradation and Atterberg limits extend a marginal amount (1 or 2 percentage points) across classification boundaries, the classification in the marginal zone is omitted in the table.

Physical and Chemical Properties

Table 17 shows estimates of some characteristics and features that affect soil behavior. These estimates are given for the major layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

Clay as a soil separate consists of mineral soil particles that are less than 0.002 millimeter in diameter. In this table, the estimated clay content of each major soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The amount and kind of clay greatly affect the fertility and physical condition of the soil. They determine the ability of the soil to adsorb cations and to retain moisture. They influence shrink-swell potential, permeability, plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earthmoving operations.

Moist bulk density is the weight of soil (ovendry) per unit volume. Volume is measured when the soil is at field moisture capacity, that is, the moisture content at ⅓-bar moisture tension. Weight is determined after drying the soil at 105 degrees C. In this table, the estimated moist bulk density of each major soil horizon is expressed in grams per cubic centimeter of soil material that is less than 2 millimeters in diameter. Bulk density data are used to compute shrink-swell potential, available water capacity, total pore space, and other soil properties. The moist bulk density of a soil indicates the pore space available for water and roots. A bulk density of more than 1.6 can restrict water storage and root penetration. Moist bulk density is influenced by texture, kind of clay, content of organic matter, and soil structure.

Permeability refers to the ability of a soil to transmit water or air. The estimates indicate the rate of downward movement of water when the soil is saturated. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Permeability is considered in the design of soil drainage systems and septic tank absorption fields.

Available water capacity refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage is given in inches of water per inch of soil for each major soil layer. The capacity varies, depending on soil properties that affect the retention of water and the depth of the root zone. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. Available water capacity is not an estimate of the quantity of water actually available to plants at any given time.

Soil reaction is a measure of acidity or alkalinity and is expressed as a range in pH values. The range in pH of each major horizon is based on many field tests. For many soils, values have been verified by laboratory

analyses. Soil reaction is important in selecting crops and other plants, in evaluating soil amendments for fertility and stabilization, and in determining the risk of corrosion.

Salinity is a measure of soluble salts in the soil at saturation. It is expressed as the electrical conductivity of the saturation extract, in millimhos per centimeter at 25 degrees C. Estimates are based on field and laboratory measurements at representative sites of nonirrigated soils. The salinity of irrigated soils is affected by the quality of the irrigation water and by the frequency of water application. Hence, the salinity of soils in individual fields can differ greatly from the value given in the table. Salinity affects the suitability of a soil for crop production, the stability of soil if used as construction material, and the potential of the soil to corrode metal and concrete.

Shrink-swell potential is the potential for volume change in a soil with a loss or gain in moisture. Volume change occurs mainly because of the interaction of clay minerals with water and varies with the amount and type of clay minerals in the soil. The size of the load on the soil and the magnitude of the change in soil moisture content influence the amount of swelling of soils in place. Laboratory measurements of swelling of undisturbed clods were made for many soils. For others, swelling was estimated on the basis of the kind and amount of clay minerals in the soil and on measurements of similar soils.

If the shrink-swell potential is rated moderate to very high, shrinking and swelling can cause damage to buildings, roads, and other structures. Special design is often needed.

Shrink-swell potential classes are based on the change in length of an unconfined clod as moisture content is increased from air-dry to field capacity. The classes are *low*, a change of less than 3 percent; *moderate*, 3 to 6 percent; and *high*, more than 6 percent. *Very high*, greater than 9 percent, is sometimes used.

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter (up to 4 percent) and on soil structure and permeability. Values of K range from 0.05 to 0.69. The higher the value, the more susceptible the soil is to sheet and rill erosion by water.

Erosion factor T is an estimate of the maximum average annual rate of soil erosion by wind or water that can occur without affecting crop productivity over a sustained period. The rate is in tons per acre per year.

Wind erodibility groups are made up of soils that have similar properties affecting their resistance to soil blowing in cultivated areas. The groups indicate the susceptibility to soil blowing. Soils are grouped according to the following distinctions:

1. Coarse sands, sands, fine sands, and very fine sands. These soils are generally not suitable for crops. They are extremely erodible, and vegetation is difficult to establish.

2. Loamy coarse sands, loamy sands, loamy fine sands, loamy very fine sands, and sapric soil material. These soils are very highly erodible. Crops can be grown if intensive measures to control soil blowing are used.

3. Coarse sandy loams, sandy loams, fine sandy loams, and very fine sandy loams. These soils are highly erodible. Crops can be grown if intensive measures to control soil blowing are used.

4L. Calcareous loams, silt loams, clay loams, and silty clay loams. These soils are erodible. Crops can be grown if intensive measures to control soil blowing are used.

4. Clays, silty clays, noncalcareous clay loams, and silty clay loams that are more than 35 percent clay. These soils are moderately erodible. Crops can be grown if measures to control soil blowing are used.

5. Noncalcareous loams and silt loams that are less than 20 percent clay and sandy clay loams, sandy clays, and hemic soil material. These soils are slightly erodible. Crops can be grown if measures to control soil blowing are used.

6. Noncalcareous loams and silt loams that are more than 20 percent clay and noncalcareous clay loams that are less than 35 percent clay. These soils are very slightly erodible. Crops can be grown if ordinary measures to control soil blowing are used.

7. Silts, noncalcareous silty clay loams that are less than 35 percent clay, and fibric soil material. These soils are very slightly erodible. Crops can be grown if ordinary measures to control soil blowing are used.

8. Soils that are not subject to soil blowing because of coarse fragments on the surface or because of surface wetness.

Organic matter is the plant and animal residue in the soil at various stages of decomposition. In table 17, the estimated content of organic matter is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The content of organic matter in a soil can be maintained or increased by returning crop residue to the soil. Organic matter affects the available water capacity, infiltration rate, and tilth. It is a source of nitrogen and other nutrients for crops.

Soil and Water Features

Table 18 gives estimates of various soil and water features. The estimates are used in land use planning that involves engineering considerations.

Hydrologic soil groups are used to estimate runoff from precipitation. Soils not protected by vegetation are assigned to one of four groups. They are grouped according to the infiltration of water when the soils are thoroughly wet and receive precipitation from long-duration storms.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a permanent high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

Flooding, the temporary inundation of an area, is caused by overflowing streams, by runoff from adjacent slopes, or by tides. Water standing for short periods after rainfall or snowmelt is not considered flooding, nor is water in swamps and marshes.

Table 18 gives the frequency and duration of flooding and the time of year when flooding is most likely.

Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions (the chance of flooding is nearly 0 percent to 5 percent in any year); *occasional* that it occurs infrequently under normal weather conditions (the chance of flooding is 5 to 50 percent in any year); and *frequent* that it occurs often under normal weather conditions (the chance of flooding is more than 50 percent in any year). Duration is expressed as *very brief* if less than 2 days, *brief* if 2 to 7 days, *long* if 7 days to 1 month, and *very long* if more than 1 month. Probable dates are expressed in months. About two-thirds to three-fourths of all flooding occurs during the stated period.

The information is based on evidence in the soil profile, namely thin strata of gravel, sand, silt, or clay deposited by floodwater; irregular decrease in organic matter content with increasing depth; and little or no horizon development.

Also considered are local information about the extent and levels of flooding and the relation of each soil on the landscape to historic floods. Information on the extent of flooding based on soil data is less specific than that provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

High water table (seasonal) is the highest level of a saturated zone in the soil in most years. The estimates are based mainly on the evidence of a saturated zone, namely grayish colors or mottles in the soil. Indicated in table 18 are depth to the seasonal high water table; the kind of water table—that is, perched or apparent; and the months of the year that the water table commonly is high. A water table that is seasonally high for less than 1 month is not indicated in table 18.

An *apparent* water table is a thick zone of free water in the soil. It is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil. A *perched* water table is water standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone.

Only saturated zones within a depth of about 6 feet are indicated. A plus sign preceding the range in depth indicates that the water table is above the surface of the soil. The first numeral in the range indicates how high the water rises above the surface. The second numeral indicates the depth below the surface.

Depth to bedrock is given if bedrock is within a depth of 5 feet. The depth is based on many soil borings and on observations during soil mapping. The rock is either soft or hard. If the rock is soft or fractured, excavations can be made with trenching machines, backhoes, or small rippers. If the rock is hard or massive, blasting or special equipment generally is needed for excavation.

Potential frost action is the likelihood of upward or lateral expansion of the soil caused by the formation of segregated ice lenses (frost heave) and the subsequent collapse of the soil and loss of strength on thawing. Frost action occurs when moisture moves into the freezing zone of the soil. Temperature, texture, density, permeability, content of organic matter, and depth to the water table are the most important factors considered in

evaluating the potential for frost action. It is assumed that the soil is not insulated by vegetation or snow and is not artificially drained. Silty and highly structured, clayey soils that have a high water table in winter are the most susceptible to frost action. Well drained, very gravelly, or very sandy soils are the least susceptible. Frost heave and low soil strength during thawing cause damage mainly to pavements and other rigid structures.

Risk of corrosion pertains to potential soil-induced electrochemical or chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors results in a severe hazard of corrosion. The steel in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than steel in installations that are entirely within one kind of soil or within one soil layer.

For uncoated steel, the risk of corrosion, expressed as *low, moderate,* or *high,* is based on soil drainage class, total acidity, electrical resistivity near field capacity, and electrical conductivity of the saturation extract.

For concrete, the risk of corrosion is also expressed as *low, moderate,* or *high.* It is based on soil texture, acidity, and amount of sulfates in the saturation extract.

Engineering Index Test Data

Table 19 shows laboratory test data for several pedons sampled at carefully selected sites in the survey area. The pedons are representative of the series described in the section "Soil Series and Their Morphology." The soil samples were tested by the Nebraska Department of Roads.

The testing methods generally are those of the American Association of State Highway and Transportation Officials (AASHTO) or the American Society for Testing and Materials (ASTM).

The tests and methods are AASHTO classification—M 145 (AASHTO), D 3282 (ASTM); Unified classification—D 2487 (ASTM); Mechanical analysis—T 88 (AASHTO), D 422 (ASTM), D 2217 (ASTM); Liquid limit—T 89 (AASHTO), D 4318 (ASTM); Plasticity index—T 90 (AASHTO), D 424 (ASTM); Moisture density, Method A—T 99 (AASHTO), D 698 (ASTM); and Specific gravity—T 100 (AASHTO), D 854 (ASTM). The group index number that is part of the AASHTO classification is computed by the Nebraska Modified System.

Classification of the Soils

The system of soil classification used by the National Cooperative Soil Survey has six categories *(5)*. Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or from laboratory measurements. Table 20 shows the classification of the soils in the survey area. The categories are defined in the following paragraphs.

ORDER. Eleven soil orders are recognized. The differences among orders reflect the dominant soil-forming processes and the degree of soil formation. Each order is identified by a word ending in *sol*. An example is Mollisol.

SUBORDER. Each order is divided into suborders primarily on the basis of properties that influence soil genesis and are important to plant growth or properties that reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Ustoll (*Ust*, meaning intermittently dry, plus *oll*, from Mollisol).

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of development of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a suborder and by a prefix that indicates a property of the soil. An example is Haplustolls (*Hapl*, meaning minimal horizonation, plus *ustoll*, the suborder of the Mollisols that has an ustic moisture regime).

SUBGROUP. Each great group has a typic subgroup. Other subgroups are intergrades or extragrades. The typic is the central concept of the great group; it is not necessarily the most extensive. Intergrades are transitions to other orders, suborders, or great groups. Extragrades have some properties that are not representative of the great group but do not indicate transitions to any other known kind of soil. Each subgroup is identified by one or more adjectives preceding the name of the great group. The adjective *Aridic* identifies the subgroup that typifies the great group. An example is Aridic Haplustolls.

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. Generally, the properties are those of horizons below plow depth where there is much biological activity. Among the properties and characteristics considered are particle-size class, mineral content, temperature regime, depth of the root zone, consistence, moisture equivalent, slope, and permanent cracks. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is coarse-silty, mixed, mesic Aridic Haplustolls.

SERIES. The series consists of soils that have similar horizons in their profile. The horizons are similar in color, texture, structure, reaction, consistence, mineral and chemical composition, and arrangement in the profile. The texture of the surface layer or of the underlying material can differ within a series.

Soil Series and Their Morphology

In this section, each soil series recognized in the survey area is described. The descriptions are arranged in alphabetic order.

Characteristics of the soil and the material in which it formed are identified for each series. The soil is compared with similar soils and with nearby soils of other series. A pedon, a small three-dimensional area of soil, that is typical of the series in the survey area is described. The detailed description of each soil horizon follows standards in the "Soil Survey Manual" *(7)*. Many of the technical terms used in the descriptions are defined in "Soil Taxonomy" *(5)*. Unless otherwise stated, matrix colors in the descriptions are for dry soil. Following the pedon description is the range of important characteristics of the soils in the series.

The map units of each soil series are described in the section "Detailed Soil Map Units."

Alda Series

The Alda series consists of very deep, somewhat poorly drained soils on bottom land. These soils formed in 20 to 40 inches of loamy alluvium over coarse sand. Permeability is moderately rapid in the upper part and

very rapid in the lower part. Slopes range from 0 to 2 percent.

Alda soils are commonly adjacent to Lex, Norwest, and Wann soils. Lex, Norwest, and Wann soils are in landscape positions similar to those of the Alda soils. Lex and Norwest soils have more clay in the control section than the Alda soils. Norwest soils do not have coarse material above a depth of 60 inches. Wann soils do not have coarse material above a depth of 40 inches.

Typical pedon of Alda fine sandy loam, 0 to 2 percent slopes, 2,450 feet west and 900 feet north of the southeast corner of sec. 20, T. 13 N., R. 40 W.

Ap—0 to 9 inches; gray (10YR 5/1) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; slightly hard, friable; strong effervescence; moderately alkaline; abrupt smooth boundary.

A—9 to 17 inches; grayish brown (10YR 5/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak medium and fine subangular blocky structure; slightly hard, friable; slight effervescence; mildly alkaline; clear smooth boundary.

AC—17 to 24 inches; brown (10YR 5/3) sandy loam, dark grayish brown (10YR 4/2) moist; weak fine subangular blocky structure; soft, very friable; mildly alkaline; clear smooth boundary.

C—24 to 32 inches; brown (10YR 5/3) sandy loam, dark brown (10YR 4/3) moist; common medium distinct yellowish brown (10YR 5/8 moist) mottles; weak fine subangular blocky structure; soft, very friable; thin strata of loam and very fine sandy loam; mildly alkaline; clear smooth boundary.

2C—32 to 60 inches; very pale brown (10YR 7/3) coarse sand, pale brown (10YR 6/3) moist; single grain; loose; neutral.

The mollic epipedon is 10 to 20 inches thick. The depth to coarse sand ranges from 20 to 40 inches.

The A horizon has value of 4 or 5 (2 or 3 moist) and chroma of 1 or 2. It is typically fine sandy loam, but the range includes sandy loam and loam. The C horizon has value of 4 to 8 (3 to 6 moist) and chroma of 1 to 3. It is typically sandy loam or fine sandy loam that has strata of fine textured or coarse textured material throughout. The 2C horizon has colors similar to those of the C horizon. It is typically coarse sand, but the range includes gravelly sand.

Altvan Series

The Altvan series consists of deep, well drained soils on uplands. These soils formed in 20 to 40 inches of loamy material over gravelly coarse sand. Permeability is moderate in the solum and very rapid in the underlying material. Slopes range from 6 to 15 percent.

Altvan soils are commonly adjacent to Dix and Satanta soils. Dix soils have very gravelly coarse sand above a depth of 10 inches. They are on narrow ridgetops and convex back slopes below the Altvan soils. Satanta soils do not have coarse material above a depth of 60 inches. They are on upper back slopes and shoulder slopes above the Altvan soils.

Typical pedon of Altvan loam, in an area of Altvan-Dix complex, 6 to 30 percent slopes; 1,550 feet north and 600 feet east of the southwest corner of sec. 18, T. 12 N., R. 41 W.

A—0 to 5 inches; brown (10YR 5/3) loam, dark brown (10YR 3/3) moist; weak medium granular structure; slightly hard, friable; neutral; clear smooth boundary.

Bt1—5 to 13 inches; brown (10YR 5/3) loam, dark brown (10YR 3/3) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; hard, firm; neutral; clear smooth boundary.

Bt2—13 to 23 inches; pale brown (10YR 6/3) loam, brown (10YR 4/3) moist; weak medium prismatic structure parting to moderate medium subangular blocky; hard, friable; neutral; clear smooth boundary.

Bk—23 to 34 inches; light brownish gray (10YR 6/2) loam, dark grayish brown (10YR 4/2) moist; weak medium subangular blocky structure; slightly hard, friable; few small soft accumulations of calcium carbonate in cracks and on faces of peds; strong effervescence; moderately alkaline; clear smooth boundary.

2C—34 to 60 inches; very pale brown (10YR 7/4) gravelly coarse sand, light yellowish brown (10YR 6/4) moist; single grain; loose; slight effervescence; mildly alkaline.

The solum is 16 to 38 inches thick. The depth to free carbonates ranges from 16 to 38 inches. The depth to gravelly coarse sand ranges from 20 to 40 inches. The mollic epipedon is 7 to 20 inches thick.

The A horizon has value of 4 or 5 (2 or 3 moist) and chroma of 2 or 3. It is typically loam, but the range includes fine sandy loam. The Bt horizon has value of 4 to 6 (3 or 4 moist) and chroma of 2 or 3. It is typically clay loam and loam, but the range includes sandy clay loam. Some pedons have a C horizon. This horizon has value of 6 to 8 (5 or 6 moist) and chroma of 2 or 3. It is typically fine sandy loam, but the range includes loam. The 2C horizon has value of 5 to 7 (5 or 6 moist) and chroma of 3 or 4. It is typically gravelly coarse sand and gravelly sand, but the range includes coarse sand.

Bankard Series

The Bankard series consists of very deep, somewhat excessively drained, rapidly permeable soils on bottom land. These soils formed in sandy alluvium. Slopes range from 0 to 2 percent.

Bankard soils are commonly adjacent to Bayard, Bridget, and Duroc soils. Bayard, Bridget, and Duroc soils are on stream terraces slightly below the Bankard soils. They have a mollic epipedon. Bayard soils have less sand in the control section than the Bankard soils. Bridget and Duroc soils have more clay and silt in the control section than the Bankard soils.

Typical pedon of Bankard loamy sand, channeled, 300 feet east and 2,200 feet north of the southwest corner of sec. 25, T. 15 N., R. 40 W.

A—0 to 6 inches; brown (10YR 5/3) loamy sand, dark brown (10YR 3/3) moist; weak fine granular structure; soft, very friable; mildly alkaline; abrupt smooth boundary.

C1—6 to 18 inches; pale brown (10YR 6/3) stratified sand that has thin lenses of loamy fine sand, brown (10YR 5/3) moist; single grain; loose; slight effervescence; mildly alkaline; gradual wavy boundary.

C2—18 to 60 inches; very pale brown (10YR 7/3) gravelly sand, brown (10YR 5/3) moist; single grain, loose; slight effervescence; about 18 percent gravel; mildly alkaline.

The A horizon has value of 5 or 6 (3 to 5 moist) and chroma of 2 to 4. It is typically loamy sand or sand. The C horizon has value of 5 to 7 (3 to 5 moist) and chroma of 2 to 4. It is typically sand and gravelly sand, but the range includes loamy very fine sand. The content of granitic gravel and calcareous sandstone rock fragments in the C horizon ranges from 5 to 25 percent.

Bayard Series

The Bayard series consists of very deep, well drained, moderately rapidly permeable soils on stream terraces. These soils formed in colluvial and alluvial sediments. Slopes range from 1 to 3 percent.

Bayard soils are commonly adjacent to Bankard, Bridget, and Duroc soils. Bankard soils have more sand in the control section than the Bayard soils. They do not have a mollic epipedon. They are on stream terraces slightly above the Bayard soils. Bridget soils have less sand in the control section than the Bayard soils. Duroc soils have more silt and clay in the control section than the Bayard soils. They have a mollic epipedon more than 20 inches thick. Bridget and Duroc soils are on stream terraces below the Bayard soils.

Typical pedon of Bayard very fine sandy loam, 1 to 3 percent slopes, 400 feet west and 900 feet north of the southeast corner of sec. 10, T. 13 N., R. 35 W.

Ap—0 to 9 inches; dark grayish brown (10YR 4/2) very fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; soft, very friable; neutral; abrupt smooth boundary.

A—9 to 16 inches; grayish brown (10YR 5/2) very fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak medium and fine subangular blocky structure; soft, very friable; neutral; clear smooth boundary.

AC—16 to 24 inches; pale brown (10YR 6/3) very fine sandy loam, brown (10YR 4/3) moist; weak medium subangular blocky structure; soft, very friable; strong effervescence; moderately alkaline; clear smooth boundary.

C1—24 to 42 inches; pale brown (10YR 6/3) very fine sandy loam, brown (10YR 4/3) moist; massive; soft, very friable; strong effervescence; moderately alkaline; clear wavy boundary.

C2—42 to 60 inches; very pale brown (10YR 7/3) loamy very fine sand, brown (10YR 5/3) moist; massive; soft, very friable; strong effervescence; moderately alkaline.

The solum is 15 to 30 inches thick. The depth to carbonates is 8 to 20 inches. The mollic epipedon is 8 to 20 inches thick.

The A horizon has value of 4 or 5 (2 or 3 moist) and chroma of 2 or 3. It is typically very fine sandy loam or fine sandy loam, but the range includes loamy very fine sand and sandy loam. The C horizon has value of 5 to 7 (4 to 6 moist) and chroma of 2 or 3. It is typically very fine sandy loam and loamy very fine sand, but the range includes fine sandy loam.

Boel Series

The Boel series consists of deep, somewhat poorly drained, rapid permeable soils on high bottom land. These soils formed in sandy alluvium. Slopes range from 0 to 2 percent.

Boel soils are commonly adjacent to Ipage, Janise, and Lawet soils. Ipage soils are moderately well drained. They do not have a mollic epipedon. They are on stream terraces above the Boel soils. Janise and Lawet soils are on bottom land below the Boel soils. Janise soils have less sand and more silt and clay in the control section than the Boel soils. They are very calcareous. Lawet soils are poorly drained. They have less sand and more silt in the control section than the Boel soils.

Typical pedon of Boel loamy fine sand, 0 to 2 percent

slopes, 300 feet south and 250 feet east of the northwest corner of sec. 31, T. 15 N., R. 37 W.

A1—0 to 13 inches; dark grayish brown (10YR 4/2) loamy fine sand, very dark grayish brown (10YR 3/2) moist, weak fine granular structure; soft, very friable; mildly alkaline; clear smooth boundary.
A2—13 to 16 inches; grayish brown (10YR 5/2) loamy fine sand, dark brown (10YR 3/3) moist; weak fine subangular blocky structure; soft, very friable; mildly alkaline; clear smooth boundary.
AC—16 to 26 inches; brown (10YR 5/3) loamy fine sand, brown (10YR 4/3) moist; weak fine subangular blocky structure; soft, very friable; strong effervescence; moderately alkaline; clear smooth boundary.
C1—26 to 34 inches; pale brown (10YR 6/3) loamy fine sand, brown (10YR 5/3) moist; few fine distinct dark yellowish brown (10YR 4/4) mottles; weak fine subangular blocky structure; soft, very friable; strong effervescence; moderately alkaline; clear smooth boundary.
C2—34 to 40 inches; light brownish gray (2.5Y 6/2) loamy fine sand, grayish brown (2.5Y 5/2) moist; weak fine subangular blocky structure; soft, very friable; strong effervescence; moderately alkaline; clear smooth boundary.
C3—40 to 60 inches; light gray (2.5Y 7/2) fine sand, light brownish gray (2.5Y 6/2) moist; single grain; loose; strong effervescence; moderately alkaline.

The mollic epipedon and solum are 10 to 20 inches thick. Some profiles have carbonates in the A horizon.

The A horizon has value of 3 to 5 (2 or 3 moist) and chroma of 2 or 3. It is loamy fine sand or fine sandy loam. The AC horizon has colors and textures that range between those of the A and C horizons. The C horizon has hue of 10YR to 2.5Y, value of 6 to 8 (5 to 7 moist), and chroma of 2 or 3. It is fine sand or loamy fine sand. It typically has lenses of light and dark material, which may also be coarse or fine textured.

Bridget Series

The Bridget series consists of very deep, well drained, moderately permeable soils on stream terraces. These soils formed in silty, calcareous colluvial and alluvial sediments. Slopes range from 0 to 3 percent.

Bridget soils are commonly adjacent to Bayard and Duroc soils. Bayard soils have more sand in the control section than the Bridget soils. They are on stream terraces slightly above the Bridget soils. Duroc soils have a mollic epipedon more than 20 inches thick. They have more clay in the control section than the Bridget soils. They are on stream terraces slightly below the Bridget soils.

Typical pedon of Bridget silt loam, 0 to 1 percent slopes, 1,100 feet south and 150 feet west of the northeast corner of sec. 9, T. 13 N., R. 39 W.

Ap—0 to 6 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; slightly hard, friable; neutral; abrupt smooth boundary.
A—6 to 12 inches; dark grayish brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak fine subangular blocky structure; slightly hard, friable; mildly alkaline; clear smooth boundary.
AC—12 to 20 inches; pale brown(10YR 6/3) silt loam, dark grayish brown (10YR 4/2) moist; weak medium subangular blocky structure; slightly hard, friable; strong effervescence; moderately alkaline; clear smooth boundary.
C—20 to 60 inches; very pale brown (10YR 7/3) silt loam, brown (10YR 4/3) moist; weak medium subangular blocky structure; soft, very friable; few small soft white accumulations of carbonates; violent effervescence; moderately alkaline.

The solum is 10 to 30 inches thick. The mollic epipedon is 7 to 18 inches thick.

The A horizon has value of 4 or 5 (2 or 3 moist) and chroma of 2 or 3. It is typically silt loam, but the range includes loam and very fine sandy loam. The AC horizon has value of 5 to 7 (4 to 5 moist) and chroma of 2 or 3. It is typically silt loam, but the range includes loam and very fine sandy loam in which the content of clay averages 10 to 18 percent. The C horizon has value of 6 to 8 (4 to 6 moist) and chroma of 2 to 4. It is typically silt loam or very fine sandy loam, but the range includes loam.

Chappell Series

The Chappell series consists of deep, well drained soils on stream terraces. These soils formed in 20 to 40 inches of loamy colluvium and alluvium over gravelly coarse sand. Permeability is moderately rapid in the solum and very rapid in the underlying material. Slopes range from 0 to 3 percent.

Chappell soils are commonly adjacent to Bridget, Duroc, and Merrick soils. Bridget, Duroc, and Merrick soils do not have coarse material above a depth of 60 inches. Bridget and Duroc soils are on stream terraces slightly above the Chappell soils. Bridget soils have less sand in the control section than the Chappell soils. Duroc soils have less sand and more clay in the control section than the Chappell soils. They have a mollic epipedon more than 20 inches thick. Merrick soils have

more clay in the control section than the Chappell soils. They are moderately well drained. They are on high bottom land below the Chappell soils.

Typical pedon of Chappell fine sandy loam, 0 to 3 percent slopes, 2,700 feet west and 2,100 feet north of the southeast corner of sec. 30, T. 13 N., R. 40 W.

Ap—0 to 7 inches; dark grayish brown (10YR 4/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; slightly hard, friable; neutral; abrupt smooth boundary.

A—7 to 17 inches; dark grayish brown (10YR 4/2) fine sandy loam, dark brown (10YR 3/3) moist; weak medium subangular blocky structure; slightly hard, friable; neutral; clear smooth boundary.

Bw—17 to 25 inches; light brown (10YR 5/3) fine sandy loam, dark grayish brown (10YR 4/2) moist; weak medium and fine subangular blocky structure; slightly hard, friable; mildly alkaline; clear smooth boundary.

C—25 to 30 inches; pale brown (10YR 6/3) fine sandy loam, brown (10YR 4/3) moist; massive; slightly hard, friable; strong effervescence; moderately alkaline; abrupt smooth boundary.

2C—30 to 60 inches; very pale brown (10YR 7/4) gravelly coarse sand, light yellowish brown (10YR 6/4) moist; single grain; loose; slight effervescence; mildly alkaline.

The solum is 15 to 30 inches thick. The mollic epipedon is 10 to 20 inches thick. The depth to the 2C horizon ranges from 20 to 40 inches.

The A horizon has value of 3 to 5 (2 or 3 moist) and chroma of 2 or 3. It is typically fine sandy loam and sandy loam, but the range includes loam or coarse sandy loam. It is slightly acid or neutral. The Bw horizon has value of 5 or 6 (4 or 5 moist) and chroma of 2 or 3. It is typically fine sandy loam or sandy loam. The C horizon has value of 5 to 8 (4 to 6 moist) and chroma of 2 to 4. It is fine sandy loam, sandy loam, or coarse sandy loam. The 2C horizon has value of 5 to 8 (4 to 6 moist) and chroma of 2 to 4. It is typically gravelly coarse sand and gravelly sand, but the range includes sand or coarse sand.

Cullison Series

The Cullison series consists of very deep, poorly drained and very poorly drained, moderately permeable soils in swales in sandhill valleys. These soils formed in sandy eolian or alluvial material and in silt. Slopes range from 0 to 2 percent.

Cullison soils are commonly adjacent to Ipage, Marlake, and Valent soils. Ipage and Valent soils have more sand in the control section than the Cullison soils. They do not have a mollic epipedon. Ipage soils are moderately well drained. They are on low hummocks above the Cullison soils. Marlake soils are very poorly drained. They have a water table at a depth of 0.5 foot to 2.0 feet above the surface during the growing season. Valent soils are excessively drained. They are on hummocks and dunes above the Cullison soils.

Typical pedon of Cullison fine sandy loam, 0 to 2 percent slopes, 150 feet west and 3,150 feet north of the southeast corner of sec. 36, T. 16 N., R. 39 W.

A—0 to 7 inches; dark gray (10YR 4/1) fine sandy loam, very dark gray (10YR 3/1) moist; weak fine granular structure; hard, friable; strong effervescence (5 percent calcium carbonate); moderately alkaline; clear smooth boundary.

Ak—7 to 18 inches; gray (10YR 5/1) fine sandy loam, very dark gray (10YR 3/1) moist; weak fine subangular blocky structure; hard, friable; violent effervescence (12 percent calcium carbonate); moderately alkaline; gradual smooth boundary.

ACk—18 to 24 inches; gray (10YR 5/1) loam, dark gray (10YR 4/1) moist; common fine distinct dark yellowish brown (10YR 4/4 moist) mottles; massive; slightly hard, friable; violent effervescence (15 percent calcium carbonate); moderately alkaline; gradual wavy boundary.

C1—24 to 50 inches; gray (10YR 6/1) loam, dark gray (10YR 4/1) moist; common fine distinct dark yellowish brown (10YR 4/4 moist) mottles; massive; slightly hard, friable; strong effervescence (8 percent calcium carbonate); moderately alkaline; gradual wavy boundary.

C2—50 to 60 inches; grayish brown (10YR 5/2) loam, dark grayish brown (10YR 4/2) moist; massive; slightly hard, friable; strong effervescence (4 percent calcium carbonate); moderately alkaline.

The solum is 18 to 30 inches thick. The mollic epipedon is 10 to 32 inches thick.

The A horizon has hue of 10YR or 2.5Y, value of 4 to 7 (2 or 3 moist), and chroma of 1 or 2. It is typically fine sandy loam, but the range includes loam. The C horizon has hue of 10YR to 5Y, value of 5 to 7 (4 or 5 moist), and chroma of 1 or 2. It is loam or fine sandy loam.

Dix Series

The Dix series consists of very deep, excessively drained soils on uplands. These soils formed in 4 to 10 inches of loamy and sandy material over very gravelly coarse sand (fig. 16). Permeability is rapid in the solum and very rapid in the underlying material. Slopes range from 3 to 60 percent.

The Dix soils in this county are a taxadjunct to the

Figure 16.—A typical profile of Dix gravelly loam. The very gravelly material is at a depth of 4 inches. Depth is marked in feet.

series because they do not have the mollic epipedon that is definitive for the series. This difference, however, does not affect the use or management of the soils. The soils of the Dix series are sandy-skeletal, mixed, mesic Torriorthentic Haplustolls.

Dix soils are commonly adjacent to Altvan, Sarben, Satanta, Sully, and Tassel soils. Altvan and Satanta soils have a mollic epipedon. Altvan soils have gravelly coarse sand at a depth of 20 to 40 inches. They have more clay in the control section than the Dix soils. Altvan, Sarben, and Sully soils are on upper back slopes above the Dix soils. Sarben, Satanta, and Sully soils do not have coarse material above a depth of 60 inches. Sarben soils are loamy throughout the control section. Satanta soils have more silt and clay in the control section than the Dix soils. They are on shoulder slopes and summits above the Dix soils. Sully soils have more silt and less sand in the control section than the Dix soils. Tassel soils are shallow to calcareous sandstone bedrock. They are on lower back slopes below the Dix soils.

Typical pedon of Dix gravelly loam, 3 to 20 percent slopes, 1,050 feet west and 1,025 feet south of the northeast corner of sec. 13, T. 13 N., R. 41 W.

A—0 to 4 inches; grayish brown (10YR 5/2) gravelly loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; soft, very friable; about 18 percent gravel; neutral; clear smooth boundary.

AC—4 to 10 inches; yellowish brown (10YR 5/4) very gravelly loamy coarse sand, brown (10YR 4/3) moist; single grain; loose; about 23 percent gravel; neutral; gradual wavy boundary.

2C—10 to 60 inches; yellowish brown (10YR 5/4) very gravelly coarse sand, yellowish brown (10YR 5/4) moist; single grain; loose; about 37 percent gravel; neutral.

The A horizon has value of 4 or 5 (2 or 3 moist) and chroma of 2 or 3. Some pedons do not have an AC horizon. The 2C horizon has value of 5 to 7 (4 to 6 moist) and chroma of 2 to 4. It is typically very gravelly coarse sand, but the range includes very gravelly sand.

Duroc Series

The Duroc series consists of deep, well drained, moderately permeable soils in upland swales and on stream terraces. These soils formed in silty local colluvium and alluvium. Slopes range from 0 to 3 percent.

Duroc soils are commonly adjacent to Bayard, Bridget, Keith, Lodgepole, and Satanta soils. Bayard, Bridget, Keith, and Satanta soils have a mollic epipedon less than 20 inches thick. Bayard and Bridget soils are on stream terraces slightly above the Duroc soils. Bayard soils have less clay and more sand in the control section than the Duroc soils. Bridget soils have less clay in the control section than the Duroc soils. Keith and Satanta soils are on shoulder slopes and summits above the Duroc soils. Lodgepole soils have more clay in the control section than the Duroc soils. They are in somewhat poorly drained depressions. Satanta soils have more sand in the control section than the Duroc soils.

Typical pedon of Duroc silt loam, 1 to 3 percent slopes, 300 feet east and 1,200 feet south of the northwest corner of sec. 13, T. 14 N., R. 40 W.

Ap—0 to 6 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; slightly hard, friable; neutral; abrupt smooth boundary.
A1—6 to 11 inches; grayish brown (10YR 5/2) silt loam, very dark gray (10YR 3/1) moist; weak medium subangular blocky structure; slightly hard, friable; mildly alkaline; gradual wavy boundary.
A2—11 to 25 inches; grayish brown (10YR 5/2) silt loam, very dark brown (10YR 2/2) moist; weak medium subangular blocky structure; slightly hard, friable; mildly alkaline; gradual wavy boundary.
ACk—25 to 50 inches; brown (10YR 5/3) silt loam, very dark grayish brown (10YR 3/2) moist; weak medium subangular blocky structure; slightly hard, friable; concretions of calcium carbonate in thin seams and streaks; strong effervescence; moderately alkaline; gradual wavy boundary.
C—50 to 60 inches; pale brown (10YR 6/3) silt loam, brown (10YR 4/3) moist; massive; slightly hard, friable; strong effervescence; moderately alkaline.

The mollic epipedon is 20 to 50 inches thick. The depth to calcareous material ranges from 10 to 36 inches.

The A horizon has value of 4 or 5 (2 or 3 moist) and chroma of 1 to 3. It is typically silt loam, but the range includes loam or very fine sandy loam. The C horizon has value of 5 to 7 (4 to 6 moist) and chroma of 2 to 4.

Gothenburg Series

The Gothenburg series consists of very deep, poorly drained soils on bottom land. These soils formed in 1 to 10 inches of sandy alluvium over gravelly coarse sand. Permeability is rapid or very rapid. Slopes range from 0 to 2 percent.

Gothenburg soils are commonly adjacent to Alda, Lex, and Platte soils. Alda and Lex soils are on bottom land above the Gothenburg soils. They have a mollic epipedon. Alda soils have more silt and clay in the control section than the Gothenburg soils. They have coarse sand at a depth of 20 to 40 inches. Lex soils have more clay in the control section than the Gothenburg soils. They have gravelly coarse sand at a depth of 20 to 40 inches. Platte soils have gravelly coarse sand at a depth of 10 to 20 inches. They are on bottom land slightly above the Gothenburg soils.

Typical pedon of Gothenburg loamy sand, 0 to 2 percent slopes, 500 feet west and 2,000 feet south of the northeast corner of sec. 22, T. 13 N., R. 40 W.

A—0 to 3 inches; grayish brown (10YR 5/2) loamy sand, dark grayish brown (10YR 3/2) moist; weak fine granular structure; soft, very friable; slight effervescence; mildly alkaline; abrupt wavy boundary.
C—3 to 8 inches; grayish brown (10YR 5/2) sand, dark grayish brown (10YR 4/2) moist; weak fine granular structure parting to single grain; soft, very friable; mildly alkaline; clear wavy boundary.
2C—8 to 60 inches; light brownish gray (10YR 6/2) gravelly coarse sand, grayish brown (10YR 5/2) moist; single grain; loose; about 18 percent gravel; neutral.

The solum is 1 to 6 inches thick. The depth to gravelly coarse sand ranges from 1 to 10 inches.

The A horizon has value of 3 to 5 (2 or 3 moist) and chroma of 1 or 2. It is typically loamy sand or loamy fine sand, but the range includes sandy loam and fine sandy loam. The C horizon has value of 6 to 8 (4 to 7 moist) and chroma of 1 to 3. It is typically sand that has strata of fine sand and gravelly sand. The 2C horizon has value of 6 to 8 (4 to 7 moist) and chroma of 1 to 3. It is sand, gravelly sand, or gravelly coarse sand in which the content of gravel ranges from 3 to 35 percent. Some pedons have thin strata of material in which the content of gravel is as much as 50 percent.

Ipage Series

The Ipage series consists of very deep, moderately well drained, rapidly permeable soils in sandhill valleys and along stream terraces. These soils formed in sandy eolian and alluvial material. Slopes range from 0 to 3 percent.

Ipage soils are commonly adjacent to Cullison, Marlake, and Valent soils. Cullison and Marlake soils are poorly drained and very poorly drained. They are in depressions below the Ipage soils. Valent soils are excessively drained. They are on hummocks and dunes above the Ipage soils.

Typical pedon of Ipage fine sand, 0 to 3 percent slopes, 1,500 feet west and 2,100 feet south of the northeast corner of sec. 20, T. 16 N., R. 37 W.

A—0 to 9 inches; grayish brown (10YR 5/2) fine sand, very dark grayish brown (10YR 3/2) moist; weak fine granular structure parting to single grain; soft, very friable; neutral; clear smooth boundary.
AC—9 to 14 inches; brown (10YR 5/3) fine sand, dark grayish brown (10YR 4/2) moist; weak fine granular structure parting to single grain; neutral; clear smooth boundary.

C1—14 to 30 inches; pale brown (10YR 6/3) fine sand, brown (10YR 4/3) moist; single grain; loose; neutral; gradual wavy boundary.

C2—30 to 60 inches; pale brown (10YR 6/3) fine sand, brown (10YR 4/3) moist; few fine distinct yellowish brown (10YR 5/8 moist) mottles; single grain; loose; neutral.

The solum is 3 to 21 inches thick.

The A horizon has value of 4 to 6 (3 or 4 moist) and chroma of 1 or 2. It is typically fine sand, but the range includes loamy sand and loamy fine sand. The AC horizon has value of 5 or 6 (4 or 5 moist) and chroma of 2 or 3. It is typically fine sand, but the range includes loamy sand and loamy fine sand. The C horizon has value of 6 to 8 (4 to 7 moist) and chroma of 2 or 3. Mottles are few or common, distinct or prominent, and gray to yellowish brown. They are within a depth of 40 inches. The C horizon is typically fine sand or sand, but the range includes loamy sand.

Janise Series

The Janise series consists of very deep, somewhat poorly drained and moderately well drained soils on bottom land. Permeability is moderately slow. These soils formed in calcareous, loamy alluvium. They have saline and alkaline characteristics. Slopes range from 0 to 2 percent.

The Janise soils in this county are a taxadjunct to the series because they do not have the mollic epipedon that is definitive for the series. This difference, however, does not affect the use and management of the soils. The soils of the Janise series are coarse-silty, mixed, (calcareous) mesic Typic Halaquepts.

Janise soils are commonly adjacent to Boel and Lawet soils. Boel soils have more sand in the control section than the Janise soils. They do not have saline and alkaline characteristics. They are on bottom land above the Janise soils. Lawet soils are less calcareous than the Janise soils. They are in poorly drained depressions below the Janise soils.

Typical pedon of Janise loam, 0 to 2 percent slopes, 2,300 feet west and 2,550 feet south of the northeast corner of sec. 3, T. 14 N., R. 37 W.

A1—0 to 3 inches; gray (10YR 5/1) loam, very dark gray (10YR 3/1) moist; moderate fine granular structure; slightly hard, very friable; strong effervescence; strongly alkaline; abrupt smooth boundary.

A2—3 to 8 inches; grayish brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; moderate and fine subangular blocky structure; slightly hard, very friable; strong effervescence; very strongly alkaline; clear smooth boundary.

AC—8 to 14 inches; light brownish gray (10YR 6/2) loam, grayish brown (10YR 5/2) moist; weak medium subangular blocky structure; hard, friable; violent effervescence; very strongly alkaline; clear smooth boundary.

C1—14 to 20 inches; light gray (10YR 7/1) loam, light brownish gray (10YR 6/2) moist; massive; hard, friable; violent effervescence; very strongly alkaline; clear wavy boundary.

C2—20 to 24 inches; white (10YR 8/1) loam, light gray (10YR 7/2) moist; massive; hard, friable; violent effervescence; very strongly alkaline; clear wavy boundary.

C3—24 to 28 inches; light gray (2.5Y 7/2) very fine sandy loam, light brownish gray (2.5Y 6/2) moist; massive; slightly hard, very friable; strong effervescence; very strongly alkaline; clear wavy boundary.

C4—28 to 44 inches; light brownish gray (2.5Y 6/2) loamy very fine sand, dark grayish brown (2.5Y 4/2) moist; few fine distinct dark yellowish brown (10YR 4/6) mottles; massive; slightly hard, very friable; slight effervescence; very strongly alkaline; abrupt wavy boundary.

C5—44 to 60 inches; pale brown (10YR 6/3) coarse sand, brown (10YR 5/3) moist; single grain; loose; strong effervescence; very strongly alkaline.

The solum is 6 to 24 inches thick. The depth to free carbonates ranges from 0 to 6 inches.

The A horizon has value of 5 to 7 (3 or 4 moist) and chroma of 1 or 2. It is typically loam, but the range includes silt loam and fine sandy loam. The AC horizon has value of 5 to 7 (3 to 5 moist) and chroma of 2. It is typically loam or silt loam, but the range includes very fine sandy loam. The C horizon has hue of 10YR or 2.5Y, value of 6 to 8, and chroma of 1 to 3. The C horizon is typically loam, very fine sandy loam, and loamy very fine sand. It is loam to coarse sand below a depth of 40 inches.

Keith Series

The Keith series consists of deep, well drained, moderately permeable soils on uplands. These soils formed in loess. Slopes range from 1 to 6 percent.

Keith soils are commonly adjacent to Duroc, Kuma, Lodgepole, and Sully soils. Duroc and Kuma soils have a mollic epipedon more than 20 inches thick. Duroc and Kuma soils are in concave and plane positions below the Keith soils. Duroc soils have less clay in the subsoil than the Keith soils. Lodgepole soils have more clay in the subsoil than the Keith soils. They are in somewhat

poorly drained, shallow depressions. Sully soils have less clay in the control section than the Keith soils. They do not have a mollic epipedon. They are on strongly sloping to steep slopes below the Keith soils.

Typical pedon of Keith silt loam, 1 to 3 percent slopes, 1,350 feet west and 650 feet north of the southeast corner of sec. 15, T. 14 N., R. 40 W.

Ap—0 to 6 inches; dark grayish brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; soft, very friable; slightly acid; abrupt smooth boundary.

A—6 to 11 inches; dark grayish brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak fine subangular blocky structure; soft, very friable; slightly acid; clear smooth boundary.

Bt1—11 to 19 inches; grayish brown (10YR 5/2) silt loam, dark brown (10YR 3/3) moist; weak coarse prismatic structure parting to weak medium subangular blocky; hard, friable; neutral; clear smooth boundary.

Bt2—19 to 26 inches; brown (10YR 5/3) silt loam, dark brown (10YR 4/3) moist; weak coarse prismatic structure parting to weak medium subangular blocky; slightly hard, friable; neutral; clear smooth boundary.

Bk—26 to 32 inches; very pale brown (10YR 7/3) silt loam, brown (10YR 5/3) moist; weak coarse prismatic structure parting to weak medium subangular blocky; soft, very friable; few soft accumulations of carbonates; strong effervescence; moderately alkaline; gradual smooth boundary.

C—32 to 60 inches; very pale brown (10YR 7/3) silt loam, brown (10YR 5/3) moist; massive; soft, very friable; strong effervescence; moderately alkaline.

The solum is 16 to 36 inches thick. The depth to carbonates ranges from 14 to 33 inches. The mollic epipedon is 8 to 20 inches thick.

The A horizon has value of 4 or 5 (2 or 3 moist) and chroma of 1 or 2. It is typically silt loam, but the range includes fine sandy loam, loam, or very fine sandy loam. The Bt horizon has value of 4 to 6 (2 to 5 moist) and chroma of 2 or 3. The darker colors are in the upper part of the horizon. The Bt horizon is silt loam, silty clay loam, or loam. The content of clay ranges from 25 to 33 percent. The content of very fine sand is high in the profiles that have a texture of loam. The Bk and C horizons have hue of 10YR or 2.5Y, value of 6 to 8 (5 or 6 moist), and chroma of 2 or 3. They are silt loam or loam.

Kuma Series

The Kuma series consists of very deep, well drained, moderately permeable soils on uplands. These soils formed in loess over a buried soil that also formed in loess (fig. 17). Slopes range from 0 to 3 percent.

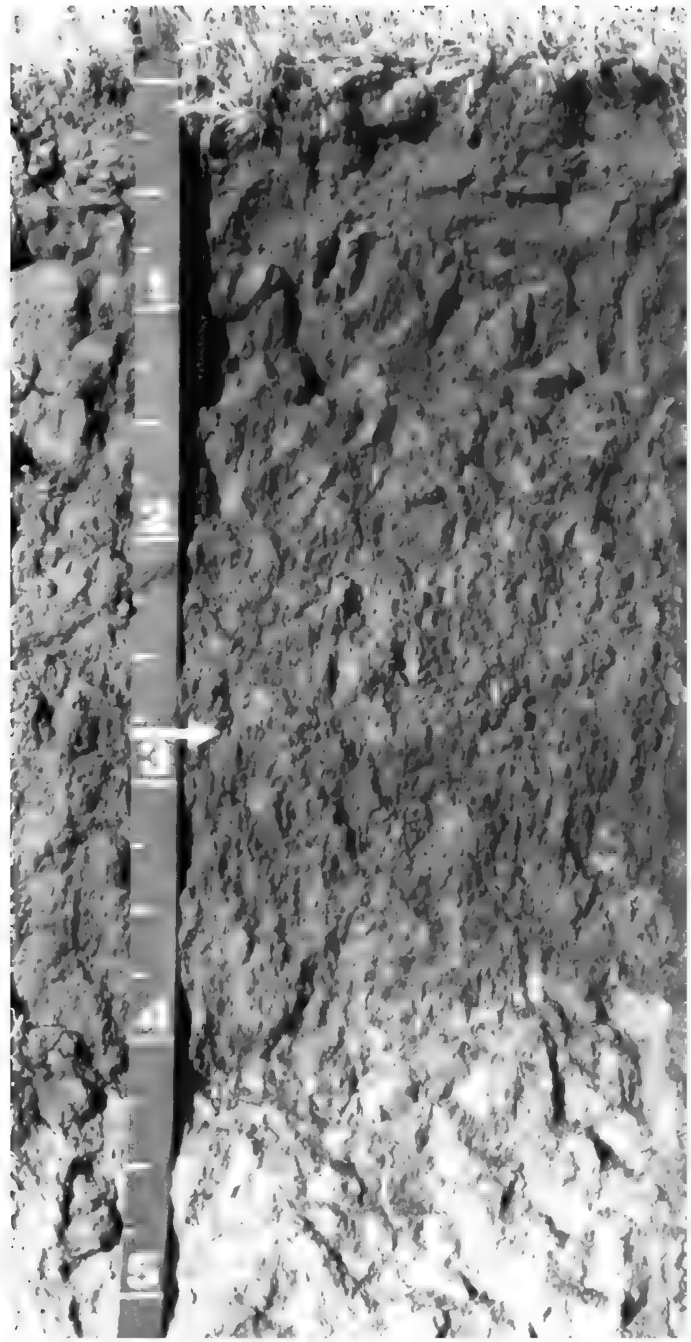

Figure 17.—A typical profile of Kuma loam. The arrow indicates the depth to a buried soil. Depth is marked in feet.

Kuma soils are commonly adjacent to Duroc, Keith, Lodgepole, Satanta, and Sully soils. Duroc soils have less clay in the subsoil than the Kuma soils. They are in landscape positions similar to those of the Kuma soils.

Keith soils have a mollic epipedon less than 20 inches thick. They are on shoulder slopes and summits above the Kuma soils. Lodgepole soils have more clay in the subsoil than the Kuma soils. They are in somewhat poorly drained, shallow potholes. Satanta soils have a mollic epipedon less than 20 inches thick, They have more sand in the control section than the Kuma soils. They are on shoulder slopes above the Kuma soils. Sully soils do not have a mollic epipedon. They have less clay in the control section than the Kuma soils. They are on back slopes below the Kuma soils.

Typical pedon of Kuma loam, 0 to 1 percent slopes, 2,300 feet east and 1,700 feet north of the southwest corner of sec. 29, T. 14 N., R. 40 W.

Ap—0 to 5 inches; dark grayish brown (10YR 4/2) loam, very dark brown (10YR 2/2) moist; weak fine granular structure; soft, very friable; few or common fine roots throughout; few or common fine discontinuous tubular pores; neutral; abrupt smooth boundary.

Bt1—5 to 12 inches; dark grayish brown (10YR 4/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; weak coarse prismatic structure parting to moderate medium subangular blocky; slightly hard, friable; few or common fine roots throughout; few or common fine discontinuous tubular pores; neutral; clear smooth boundary.

Btb1—12 to 19 inches; dark grayish brown (10YR 4/2) silty clay loam, black (10YR 2/1) moist; weak coarse prismatic structure parting to moderate to strong medium subangular blocky; slightly hard, friable; few or common fine roots throughout; few or common fine discontinuous tubular pores; many continuous faint black (10YR 2/1) organic coatings on vertical and horizontal faces of peds; neutral; clear smooth boundary.

Btb2—19 to 24 inches; dark grayish brown (10YR 4/2) silty clay loam, very dark brown (10YR 2/2) moist; weak coarse prismatic structure parting to weak to moderate medium and coarse subangular blocky; slightly hard, friable; few or common fine roots throughout; few or common fine discontinuous tubular pores; many continuous faint very dark brown (10YR 2/2) organic coatings on vertical and horizontal faces of peds; neutral; clear smooth boundary.

Btb3—24 to 30 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak coarse prismatic structure parting to moderate medium subangular blocky; slightly hard, friable; very few to few fine roots throughout; slight effervescence; moderately alkaline; clear smooth boundary.

Bk—30 to 36 inches; pale brown (10YR 6/3) loam, brown (10YR 5/3) moist; weak coarse prismatic structure parting to weak coarse subangular blocky; slightly hard, friable; thin seams and streaks of secondary calcium carbonate; very few to fine roots throughout; violent effervescence; moderately alkaline; gradual wavy boundary.

C1—36 to 49 inches; very pale brown (10YR 7/3) loam, brown (10YR 5/3) moist; weak coarse prismatic structure; soft, very friable; very few to few fine roots throughout; violent effervescence; moderately alkaline; gradual wavy boundary.

C2—49 to 60 inches; light gray (10YR 7/2) loam, grayish brown (10YR 5/2) moist; massive; soft, very friable; very few to few fine roots throughout; strong effervescence; moderately alkaline.

The solum is 30 to more than 60 inches thick. The mollic epipedon is 20 to 50 inches thick.

The A horizon has value of 4 or 5 (2 or 3 moist) and chroma of 1 to 3. It is typically loam, but the range includes silt loam. The Bt horizon has value of 4 or 5 (2 or 3 moist) and chroma of 1 to 3. It is typically silty clay loam or loam. The Btb horizon has value of 4 or 5 (2 or 3 moist) and chroma of 1 to 3. It is typically silt loam or silty clay loam, but the range includes loam. The C horizon has value of 6 or 7 (5 or 6 moist) and chroma of 2 to 4. It is typically loam, but the range includes silty clay loam and very fine sandy loam.

Lawet Series

The Lawet series consists of very deep, poorly drained, moderate or moderately slowly permeable soils on high bottom land. These soils formed in loamy eolian or alluvial sediments. Slopes range from 0 to 2 percent.

Lawet soils are commonly adjacent to Boel, Ipage, and Janise soils. Boel and Ipage soils have more sand in the control section than the Lawet soils. They are in landscape positions higher than those of the Lawet soils. Boel soils are somewhat poorly drained. Ipage soils are moderately well drained. Janise soils are highly alkaline. They are on bottom land slightly above the Lawet soils.

Typical pedon of Lawet loam, 0 to 2 percent slopes, 1,000 feet west and 100 feet north of the southeast corner of sec. 2, T. 14 N., R. 37 W.

A—0 to 10 inches; gray (10YR 5/1) loam, very dark gray (10YR 3/1) moist; weak fine granular structure; hard, friable; violent effervescence; mildly alkaline; clear smooth boundary.

ABk—10 to 20 inches; gray (10YR 5/1) sandy clay loam, very dark gray (10YR 3/1) moist; weak fine subangular blocky structure; hard, friable; violent

effervescence; mildly alkaline; gradual smooth boundary.

Bk—20 to 26 inches; gray (10YR 6/1) sandy clay loam, dark gray (10YR 4/1) moist; weak fine subangular blocky structure; slightly hard, friable; violent effervescence; mildly alkaline; gradual wavy boundary.

C1—26 to 41 inches; gray (10YR 6/1) sandy clay loam, dark gray (10YR 4/1) moist; massive; slightly hard, friable; violent effervescence; mildly alkaline; gradual wavy boundary.

C2—41 to 60 inches; light brownish gray (2.5Y 6/2) sandy clay loam, dark grayish brown (2.5Y 4/2) moist; few fine distinct strong brown (7.5YR 5/6) mottles; massive; slightly hard, friable; strong effervescence; mildly alkaline.

The solum is 7 to 24 inches thick. The mollic epipedon is 7 to 20 inches thick.

The A horizon has hue of 10YR or 2.5Y, value of 3 to 5 (2 or 3 moist), and chroma of 1 or 2. It is typically loam, but the range includes very fine sandy loam and fine sandy loam. The Bk horizon has hue of 10YR or 2.5Y, value of 5 or 6 (4 or 5 moist), and chroma of 1 or 2. It is typically sandy clay loam, but the range includes clay loam and silty clay loam. The C horizon has hue of 10YR or 2.5Y, value of 5 to 7 (2 to 5 moist), and chroma of 1 or 2. It is sandy clay loam, clay loam, or silty clay loam.

Lex Series

The Lex series consists of deep, somewhat poorly drained soils on bottom land. These soils formed in 20 to 40 inches of loamy and silty alluvium over gravelly coarse sand. Permeability is moderate in the solum and very rapid in the underlying material. Slopes range from 0 to 2 percent.

Lex soils are commonly adjacent to Alda, Norwest, and Wann soils. Alda, Norwest, and Wann soils are in landscape positions similar to those of the Lex soils. Alda and Wann soils have less clay in the control section than the Lex soils. Norwest and Wann soils do not have coarse material above a depth of 60 inches.

Typical pedon of Lex loam, 0 to 2 percent slopes, 200 feet west and 2,800 feet south of the northeast corner of sec. 13, T. 13 N., R. 40 W.

Ap—0 to 7 inches; gray (10YR 5/1) loam, very dark gray 10YR 3/1) moist; weak fine granular structure; hard, friable; strong effervescence; mildly alkaline; abrupt smooth boundary.

A—7 to 11 inches; gray (10YR 5/1) silt loam, very dark gray (10YR 3/1) moist; moderate medium subangular blocky structure; hard, friable; violent effervescence; moderately alkaline; clear smooth boundary.

Bk—11 to 19 inches; gray (10YR 6/1) silty clay loam, dark gray (10YR 4/1) moist; common medium prominent brown (7.5YR 4/4) mottles; moderate medium subangular blocky structure; hard, friable; few small accumulations of calcium carbonate; violent effervescence; moderately alkaline; gradual wavy boundary.

C—19 to 24 inches; gray (10YR 5/1) fine sandy loam, dark grayish brown (10YR 4/2) moist; common medium prominent brown (7.5YR 4/4) mottles; weak medium and fine subangular blocky structure; slightly hard, friable; slight effervescence; mildly alkaline; abrupt smooth boundary.

2C—24 to 60 inches; light gray (10YR 7/2) gravelly coarse sand, light brownish gray (10YR 6/2) moist; single grain; loose; mildly alkaline.

The mollic epipedon is 10 to 24 inches thick. The depth to gravelly coarse sand ranges from 20 to 40 inches.

The A horizon has value of 3 to 5 (2 or 3 moist) and chroma of 1 or 2. It is typically silt loam and loam, but the range includes silty clay loam. The AC horizon has value of 4 to 7 (3 to 6 moist) and chroma of 1 to 3. It is typically silty clay loam and loam, but the range includes silt loam or fine sandy loam. The C horizon has value of 5 to 7 (4 to 6 moist) and chroma of 2 or 3. It is typically fine sandy loam or loam. Some pedons are stratified. The 2C horizon is gravelly coarse sand or gravelly sand.

Lodgepole Series

The Lodgepole series consists of very deep, somewhat poorly drained, very slowly permeable soils in potholes on uplands. These soils formed in loess. Slopes are 0 to 1 percent.

Lodgepole soils are commonly adjacent to Duroc, Keith, Kuma, and Satanta soils. Duroc, Keith, Kuma, and Satanta soils have less clay in the subsoil than the Lodgepole soils. They are well drained. Keith, Kuma, and Satanta soils are on summits and shoulder slopes above the Lodgepole soils. Duroc soils are in landscape positions slightly higher than those of the Lodgepole soils.

Typical pedon of Lodgepole silt loam, 0 to 1 percent slopes, 100 feet west and 600 feet south of the northeast corner of sec. 10, T. 12 N., R. 39 W.

Ap—0 to 7 inches; gray (10YR 5/1) silt loam, very dark gray 10YR 3/1) moist; moderate fine granular structure; slightly hard, friable; slightly acid; abrupt smooth boundary.

Bt1—7 to 28 inches; dark gray (10YR 4/1) silty clay loam, very dark gray (10YR 3/1) moist; strong medium subangular blocky structure; extremely hard, very firm; shiny faces on most peds; neutral; gradual wavy boundary.

Bt2—28 to 48 inches; gray (10YR 5/1) silty clay loam, dark gray (10YR 4/1) moist; moderate coarse prismatic structure parting to moderate medium subangular blocky; extremely hard, very firm; shiny faces on most peds; neutral; gradual wavy boundary.

Bk—48 to 60 inches; brown (10YR 5/3) silty clay loam, dark brown (10YR 4/3) moist; moderate medium subangular blocky structure; hard, firm; few hard accumulations of calcium carbonate; slight effervescence; mildly alkaline.

The depth to carbonates ranges from 35 to 60 inches. The mollic epipedon is 20 to 41 inches thick.

The A horizon has value of 4 or 5 (2 or 3 moist) and chroma of 1 or 2. The Bt horizon has hue of 10YR or 2.5Y, value of 3 to 5 (2 to 4 moist), and chroma of 1 or 2. It is typically silty clay loam, but the range includes clay loam. The content of clay ranges from 35 to 50 percent. Some pedons have a C horizon.

Marlake Series

The Marlake series consists of very deep, very poorly drained, rapidly permeable soils in swales in sandhill valleys. In some places the soils are in depressions that border lakes and streams. These soils formed in sandy eolian material and in sandy and loamy alluvium. Slopes are 0 to 1 percent.

Marlake soils are commonly adjacent to Cullison and Ipage soils. Cullison soils have a lower water table than the Marlake soils. They have a mollic epipedon. They have more carbonates in the profile than the Marlake soil. They are in landscape positions slightly higher than those of the Marlake soils. Ipage soils have a water table at a depth of 3 to 6 feet. They are on low hummocks above the Marlake soils.

Typical pedon of Marlake fine sandy loam, 0 to 1 percent slopes, 1,300 feet east and 2,100 feet north of the southwest corner of sec. 30, T. 16 N., R. 38 W.

Oe—2 inches to 0; partly decomposed grass litter; mildly alkaline; abrupt smooth boundary.

A—0 to 8 inches; gray (10YR 5/1) fine sandy loam, very dark gray (10YR 3/1) moist; single grain; soft, very friable; mildly alkaline; clear smooth boundary.

C—8 to 60 inches; light gray (10YR 7/1) fine sand, gray (10YR 5/1) moist; strata of fine sandy loam and loamy sand; single grain; soft, very friable; mildly alkaline.

The solum is 6 to 20 inches thick. The mollic epipedon is 6 to 10 inches thick. Some pedons are calcareous throughout.

The A horizon has value of 4 or 5 (2 or 3 moist) and chroma of 1 or 2. It is typically fine sandy loam, but the range includes loamy fine sand and fine sand. Some pedons may have an AC horizon. The C horizon has value of 5 to 7 (4 to 6 moist) and chroma of 1 or 2. It is typically fine sand, but the range includes sand.

McConaughy Series

The McConaughy series consists of deep, well drained, moderately permeable soils on uplands. These soils formed in silty calcareous loess. Slopes range from 6 to 15 percent.

McConaughy soils are commonly adjacent to Keith, Kuma, and Sully soils. Keith and Kuma soils have more clay in the subsoil than the McConaughy soils. They are on summits and shoulder slopes above the McConaughy soils. Kuma soils have a mollic epipedon more than 20 inches thick. Sully soils do not have a mollic epipedon. They are on the steeper slopes above the McConaughy soils.

Typical pedon of McConaughy silt loam, in an area of Sully-McConaughy silt loams, 9 to 30 percent slopes; 475 feet east and 1,260 feet south of the northwest corner of sec. 4, T. 14 N., R. 41 W.

A1—0 to 6 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak medium subangular blocky structure parting to weak fine granular; slightly hard, friable; mildly alkaline; clear smooth boundary.

A2—6 to 13 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak medium subangular blocky structure parting to weak fine granular; slightly hard, friable; mildly alkaline; clear smooth boundary.

Bw1—13 to 17 inches; brown (10YR 5/3) silt loam, brown (10YR 4/3) moist; weak coarse prismatic structure parting to weak medium subangular blocky; slightly hard, friable; slight effervescence; mildly alkaline; clear smooth boundary.

Bw2—17 to 22 inches; pale brown (10YR 6/3) silt loam, brown (10YR 5/3) moist; weak coarse prismatic structure parting to weak medium subangular blocky; slightly hard, friable; strong effervescence; moderately alkaline; gradual wavy boundary.

BC—22 to 34 inches; very pale brown (10YR 7/3) silt loam, brown (10YR 5/3) moist; weak coarse prismatic structure parting to weak medium subangular blocky; slightly hard, friable; few small soft white accumulations of secondary carbonates;

violent effervescence; moderately alkaline; gradual wavy boundary.

C1—34 to 40 inches; very pale brown (10YR 7/3) silt loam, brown (10YR 5/3 moist; massive; slightly hard, friable; few small soft white accumulations of secondary carbonates; strong effervescence; moderately alkaline; diffuse wavy boundary.

C2—40 to 60 inches; very pale brown (10YR 7/3) silt loam, brown (10YR 5/3 moist; massive; slightly hard, friable; few small soft white accumulations of secondary carbonates; strong effervescence; moderately alkaline.

The solum is 19 to 40 inches thick. The depth to carbonates ranges from 10 to 18 inches. The mollic epipedon is 7 to 20 inches thick. Reaction ranges from neutral to moderately alkaline throughout.

The A horizon has value of 4 or 5 (2 or 3 moist) and chroma of 2 or 3. It is typically silt loam, but the range includes very fine sandy loam. The Bw horizon has value of 5 to 7 (4 or 5 moist) and chroma of 2 or 3. It is typically silt loam, but the range includes very fine sandy loam. The C horizon has value of 5 to 7 (4 or 5 moist) and chroma of 2 or 3.

Merrick Series

The Merrick series consists of deep, moderately well drained, moderately permeable soils on high bottom land. These soils formed in stratified silty and loamy alluvium. Slopes range from 0 to 2 percent.

Merrick soils are commonly adjacent to Bayard, Chappell, and Duroc soils. Bayard, Chappell, and Duroc soils are on stream terraces above the Merrick soils. Bayard and Chappell soils have less clay in the control section than the Merrick soils. Bayard and Duroc soils are well drained. Chappell soils have gravelly coarse sand at a depth of 20 to 40 inches. Duroc soils have less sand in the control section than the Merrick soils.

Typical pedon of Merrick loam, 0 to 2 percent slopes, 100 feet south and 2,200 feet east of the northwest corner of sec. 31, T. 13 N., R. 40 W.

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; hard, friable; neutral; abrupt smooth boundary.

A1—8 to 13 inches; dark gray (10YR 4/1) loam, very dark gray (10YR 3/1) moist; moderate medium subangular blocky structure; hard, friable; neutral; clear smooth boundary.

A2—13 to 25 inches; dark gray (10YR 4/1) loam, black (10YR 2/1) moist; moderate medium subangular blocky structure; hard, friable; neutral; clear smooth boundary.

C1—25 to 42 inches; grayish brown (10YR 5/2) clay loam, dark grayish brown (10YR 4/2) moist; moderate medium and fine subangular blocky structure; very hard, firm; mildly alkaline; clear wavy boundary.

C2—42 to 48 inches; grayish brown (10YR 5/2) clay loam, dark grayish brown (10YR 4/2) moist; few fine distinct dark yellowish brown (10YR 4/4) mottles; moderate medium subangular blocky structure; very hard, firm; common fine soft masses of carbonates; violent effervescence; moderately alkaline; clear wavy boundary.

C3—48 to 60 inches; grayish brown (10YR 5/2) loam, dark grayish brown (10YR 4/2) moist; few medium distinct dark yellowish brown (10YR 4/4) mottles; weak medium subangular blocky structure; very hard, firm; common fine soft masses of carbonates; violent effervescence; moderately alkaline.

The mollic epipedon and solum are 20 to 38 inches thick. Free carbonates are typically below a depth of 40 inches, but the range includes a depth of 30 to 60 inches.

The A horizon has value of 4 or 5 (2 or 3 moist) and chroma of 1 or 2. It is dominantly loam, but the range includes silt loam or very fine sandy loam. The C horizon has value of 5 to 7 (4 to 6 moist) and chroma of 2 or 3. It is typically clay loam or loam. It has strata that have higher and lower values and varying textures. Reaction is neutral or mildly alkaline throughout.

Norwest Series

The Norwest series consists of deep, somewhat poorly drained, moderately permeable soils on bottom land. These soils formed in loamy calcareous alluvium. Slopes range from 0 to 2 percent.

Norwest soils are commonly adjacent to Alda, Lex, and Wann soils. Alda, Lex, and Wann soils are in landscape positions similar to those of the Norwest soils. Alda and Wann soils have less clay in the control section than the Norwest soils. Alda soils have coarse sand at a depth of 20 to 40 inches. Lex soils have gravelly coarse sand at a depth of 20 to 40 inches.

Typical pedon of Norwest loam, 0 to 2 percent slopes, 1,000 feet west and 500 feet north of the southeast corner of sec. 3, T. 13 N., R. 38 W.

Ap—0 to 7 inches; dark gray (10YR 4/1) loam, black (10YR 2/1) moist; weak fine granular structure; slightly hard, friable; strong effervescence; mildly alkaline; abrupt smooth boundary.

A1—7 to 11 inches; dark gray (10YR 4/1) loam, very dark gray (10YR 3/1) moist; weak fine subangular blocky structure; slightly hard, friable; strong

effervescence; mildly alkaline; clear smooth boundary.

A2—11 to 15 inches; gray (10YR 5/1) loam, very dark grayish brown (10YR 3/2) moist; weak fine subangular blocky structure; slightly hard, friable; strong effervescence, moderately alkaline; clear smooth boundary.

Bk—15 to 34 inches; light gray (10YR 7/2) loam, grayish brown (10YR 5/2) moist; moderate fine subangular blocky structure; slightly hard, friable; violent effervescence; moderately alkaline; 20 percent calcium carbonate equivalent; clear smooth boundary.

C1—34 to 39 inches; light brownish gray (10YR 6/2) very fine sandy loam, grayish brown (10YR 5/2 moist; common fine distinct dark yellowish brown (10YR 4/6) mottles; massive; slightly hard, friable; strong effervescence; moderately alkaline; abrupt smooth boundary.

C2—39 to 60 inches; stratified light brownish gray (2.5Y 6/2) and gray (2.5Y 5/0) clay loam and loamy sand, grayish brown (2.5Y 5/2) and very dark grayish brown (2.5Y 3/2) moist; common and medium and coarse distinct dark yellowish brown (10YR 4/6) mottles; massive; slightly hard, friable; few small soft accumulations of carbonates; strong effervescence; moderately alkaline.

The solum is 20 to 38 inches thick. The mollic epipedon is 10 to 20 inches thick. Free carbonates are at the surface and throughout the profile.

The A horizon has value of 3 to 5 (2 or 3 moist) and chroma of 1 or 2. Reaction is mildly or moderately alkaline. The Bk horizon has value of 6 or 7 (5 or 6 moist) and chroma of 1 or 2. It is typically loam or clay loam. The C horizon has hue of 10YR or 2.5Y, value of 5 to 7 (3 to 6 moist), and chroma of 0 to 2. It is typically stratified very fine sandy loam, clay loam, and loamy sand, but the range includes loam and fine sandy loam.

Otero Series

The Otero series consists of very deep, well drained, moderately rapidly permeable soils on alluvial fans below escarpments of sedimentary rock. These soils formed in colluvial and alluvial sediments. Slopes range from 15 to 30 percent.

The Otero soils in this county are a taxadjunct to the series because the climate is more humid than is definitive for the series. This difference, however, does not affect the use and management of the soils. The soils of the Otero series are coarse-loamy, mixed (calcareous) mesic Ustic Torriorthents.

Otero soils are commonly adjacent to areas of rock outcrop and to Tassel soils. The areas of rock outcrop are on ledges above the Otero soils on the steep or very steep back slopes. Tassel soils are shallow over bedrock. They are on the upper back slopes above the Otero soils.

Typical pedon of Otero very fine sandy loam, in an area of Tassel-Otero-Rock outcrop complex, 15 to 60 percent slopes; 1,100 feet east and 3,050 feet north of the southwest corner of sec. 36, T. 15 N., R. 41 W.

A—0 to 5 inches; grayish brown (10YR 5/2) very fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; slightly hard, friable; mildly alkaline; clear smooth boundary.

AC—5 to 8 inches; pale brown (10YR 6/3) very fine sandy loam, brown (10YR 4/3) moist; weak fine subangular blocky structure; slightly hard, friable; common small calcareous sandstone chips and fragments; strong effervescence; moderately alkaline; gradual wavy boundary.

C—8 to 60 inches; very pale brown (10YR 7/3) very fine sandy loam, yellowish brown (10YR 5/4) moist; massive; slightly hard, friable; many small and large calcareous sandstone chips and fragments; violent effervescence; moderately alkaline.

The solum is 4 to 12 inches thick. Some pedons are calcareous at the surface but are noncalcareous at a depth of 1 to 10 inches.

The A horizon has value of 5 to 7 (3 to 6 moist) and chroma of 2 to 4. It is typically very fine sandy loam, but the range includes sandy loam. The C horizon has value of 5 to 7 (4 to 6 moist). It is typically very fine sandy loam or sandy loam.

Platte Series

The Platte series consists of very deep, somewhat poorly drained soils on low bottom land. These soils formed in 10 to 20 inches of sandy and loamy alluvium over gravelly coarse sand. Permeability is moderate to very rapid. Slopes range from 0 to 2 percent.

Platte soils are commonly adjacent to Alda, Gothenburg, and Lex soils. Alda and Lex soils have a mollic epipedon. They are on bottom land slightly above the Platte soils. Alda soils have coarse sand at a depth of 20 to 40 inches. Gothenburg soils have gravelly coarse sand above a depth of 10 inches. They are on bottom land slightly below the Platte soils. Lex soils have gravelly coarse sand at a depth of 20 to 40 inches. They have more clay in the control section than the Platte soils.

Typical pedon of Platte loam, 0 to 2 percent slopes, 150 feet east and 1,650 feet south of the northwest corner of sec. 20, T. 14 N., R. 35 W.

A—0 to 5 inches; dark gray (10YR 4/1) loam, very dark

grayish brown (10YR 3/2) moist; weak fine granular structure; slightly hard, friable; strong effervescence; moderately alkaline; clear smooth boundary.

AC—5 to 11 inches; light brownish gray (10YR 6/2) fine sandy loam, dark grayish brown (10YR 4/2) moist; few fine distinct dark yellowish brown (10YR 4/4 moist) mottles; weak medium and fine subangular blocky structure; soft, very friable; strong effervescence; moderately alkaline; clear smooth boundary.

C—11 to 18 inches; pale brown (10YR 6/3) fine sandy loam, brown (10YR 4/3) moist; few fine distinct dark yellowish brown (10YR 4/4 moist) mottles; weak fine subangular blocky structure; soft, very friable; mildly alkaline; clear wavy boundary.

2C—18 to 60 inches; pale brown (10YR 6/3) gravelly coarse sand, brown (10YR 5/3) moist; single grain; loose; about 23 percent gravel; mildly alkaline.

The solum is 5 to 12 inches thick. The depth to gravelly sand or gravelly coarse sand ranges from 10 to 20 inches.

The A horizon has value of 4 or 5 (2 or 3 moist) and chroma of 1 or 2. It is typically loam or fine sandy loam, but the range includes sandy loam and loamy fine sand. The C horizon has value of 6 to 8 (4 to 6 moist) and chroma of 1 to 3. It is typically fine sandy loam or very fine sandy loam, but the range includes loam. The 2C horizon has colors similar to those of the C horizon. It is commonly gravelly coarse sand or coarse sand.

Rosebud Series

The Rosebud series consists of moderately deep, well drained, moderately permeable soils on uplands. These soils formed in calcareous, loamy material weathered from very fine grained sandstone bedrock. Slopes range from 1 to 9 percent.

Rosebud soils are commonly adjacent to Kuma and Satanta soils. Kuma and Satanta soils are very deep. Kuma soils have less sand in the control section than the Rosebud soils. They have a mollic epipedon more than 20 inches thick. They are in plane or concave positions below the Rosebud soils. Satanta soils are in landscape positions similar to those of the Rosebud soils.

Typical pedon of Rosebud loam, 1 to 3 percent slopes, 110 feet south and 1,675 feet east of the northwest corner of sec. 16, T. 12 N., R. 39 W.

Ap—0 to 6 inches; grayish brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; slightly hard, friable; neutral; abrupt smooth boundary.

Bt1—6 to 13 inches; dark grayish brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) moist; weak medium prismatic structure parting to moderate medium subangular blocky; hard, firm; neutral; clear smooth boundary.

Bt2—13 to 21 inches; pale brown (10YR 6/3) loam, brown (10YR 4/3) moist; weak medium prismatic structure parting to moderate medium subangular blocky; hard, firm; mildly alkaline; clear smooth boundary.

Bk—21 to 30 inches; light gray (10YR 7/2) loam, pale brown (10YR 6/3) moist; moderate medium subangular blocky structure; slightly hard, friable; few soft white masses of calcium carbonate; strong effervescence; moderately alkaline; abrupt wavy boundary.

Cr—30 to 36 inches; white (10YR 8/2) very fine grained sandstone bedrock; violent effervescence.

The solum is 12 to 30 inches thick. The depth to the Cr horizon ranges from 20 to 40 inches. The depth to free carbonates ranges from 9 to 30 inches.

The A horizon has value of 4 or 5 (2 or 3 moist) and chroma of 2 or 3. It is typically loam, but the range includes silt loam and fine sandy loam. The Bt horizon has value of 4 to 6 (3 or 4 moist) and chroma of 2 or 3. It is typically clay loam or loam. The Bk horizon has value of 6 or 7 (5 or 6 moist) and chroma of 2 or 3. It is typically loam, but the range includes clay loam and sandy clay loam. Some pedons have a C horizon. This horizon has value of 6 or 7 (5 or 6 moist) and chroma of 3 or 4. It is typically sandy loam or sandy clay loam. The Cr horizon has value of 7 or 8 (6 or 7 moist) and chroma of 2 to 6.

Sarben Series

The Sarben series consists of very deep, well drained, moderately rapidly permeable soils on uplands. These soils formed in sandy and loamy eolian material. Slopes range from 0 to 20 percent.

The Sarben soils are in a more humid climate than is definitive for the series. This difference, however, does not affect the use or management of the soils.

Sarben soils are commonly adjacent to Satanta, Valent, and Vetal soils. Satanta soils have a mollic epipedon. They have more clay in the control section than the Sarben soils. They are in landscape positions lower than those of the Sarben soils. Valent soils have more sand and less silt in the control section than the Sarben soils. They are on hummocks and dunes. Vetal soils have a mollic epipedon more than 20 inches thick. They are in swales below the Sarben soils.

Typical pedon of Sarben loamy fine sand, 6 to 9 percent slopes, 125 feet south and 700 feet west of the

northeast corner of sec. 6, T. 12 N., R. 35 W.

Ap—0 to 5 inches; grayish brown (10YR 5/2) loamy fine sand, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; soft, very friable; slightly acid; clear smooth boundary.

AC—5 to 11 inches; brown (10YR 5/3) very fine sandy loam, dark grayish brown (10YR 4/2) moist; weak medium subangular blocky structure; soft, very friable; slightly acid; clear smooth boundary.

C1—11 to 35 inches; pale brown (10YR 6/3) very fine sandy loam, brown (10YR 4/3) moist; massive; soft, very friable; neutral.

C2—35 to 60 inches; pale brown (10YR 6/3) loamy very fine sand, brown (10YR 4/3) moist; massive; soft, very friable; slight effervescence; neutral.

The depth to free carbonates ranges from 15 to 40 inches.

The A horizon has value of 4 to 6 (3 or 4 moist) and chroma of 2 or 3. It is loamy fine sand, but the range includes fine sandy loam and loamy very fine sand. The AC horizon has value of 5 or 6 (4 or 5 moist) and chroma of 2 or 3. It is typically very fine sandy loam or loamy very fine sand. The C horizon has value of 5 to 7 (4 to 6 moist) and chroma of 2 or 3. It is typically very fine sandy loam and loamy very fine sand.

Satanta Series

The Satanta series consists of deep, well drained, moderately permeable soils on uplands. These soils formed in loamy eolian material (fig. 18). Slopes range from 0 to 9 percent.

Satanta soils are commonly adjacent to Altvan, Dix, Kuma, and Lodgepole soils. Altvan and Dix soils are on the steeper slopes. Altvan soils have gravelly coarse sand at a depth of 20 to 40 inches. Dix soils have very gravelly coarse sand above a depth of 10 inches. They do not have a mollic epipedon. Kuma soils have less sand in the control section than the Satanta soils. They have a mollic epipedon more than 20 inches thick. They are in plane or concave positions below the Satanta soils. Lodgepole soils have less sand and more clay in the control section than the Satanta soils. They are in somewhat poorly drained depressions.

Typical pedon of Satanta loam, 1 to 3 percent slopes, 200 feet west and 2,050 feet north of the southeast corner of sec. 11, T. 12 N., R. 40 W.

Ap—0 to 6 inches; grayish brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; slightly hard, friable; neutral; abrupt smooth boundary.

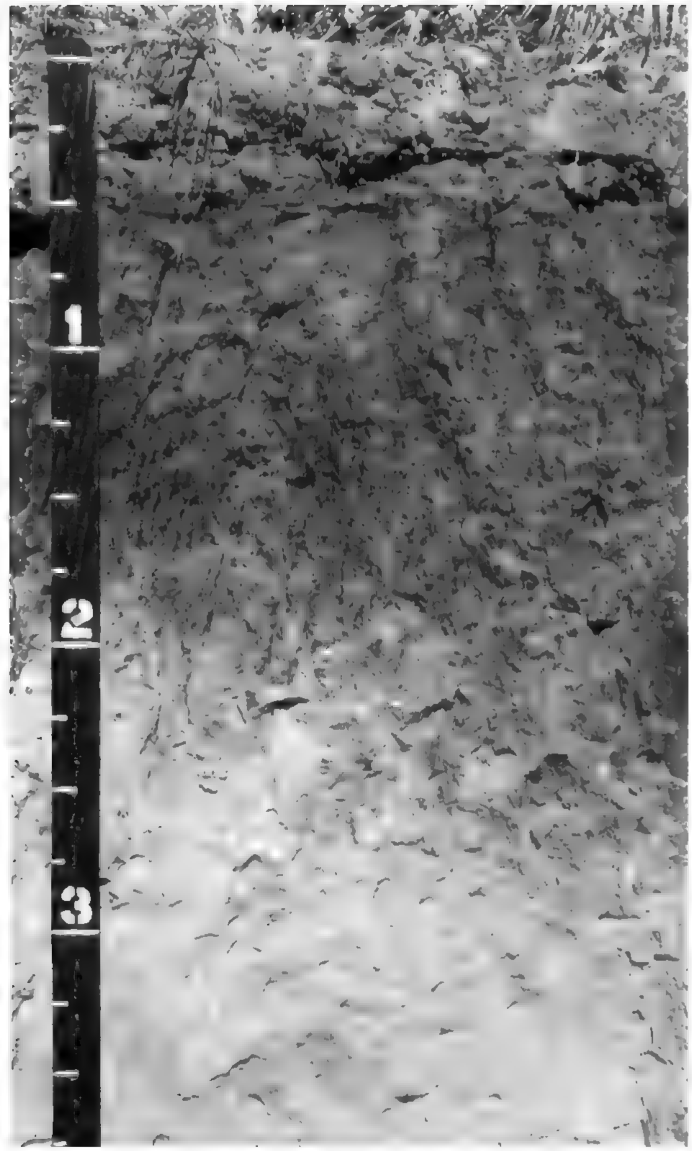

Figure 18.—A typical profile of Satanta loam. Depth is marked in feet.

Bt1—6 to 15 inches; dark grayish brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; moderate medium subangular blocky structure; hard, friable; mildly alkaline; clear smooth boundary.

Bt2—15 to 24 inches; brown (10YR 5/3) loam, dark brown (10YR 4/3) moist; moderate medium subangular blocky structure; hard, friable; mildly alkaline; clear smooth boundary.

Bk—24 to 34 inches; light gray (10YR 7/2) loam, light brownish gray (10YR 6/2) moist; weak medium and fine subangular blocky structure; hard, friable;

calcium carbonate in structural cracks and on faces of peds; strong effervescence; moderately alkaline; clear smooth boundary.

C1—34 to 42 inches; pale brown (10YR 6/3) loam, brown (10YR 5/3) moist; massive; few fine and medium granitic pebbles; slightly hard, friable; strong effervescence; moderately alkaline; gradual smooth boundary.

C2—42 to 60 inches; very pale brown (10YR 7/3) loam, brown (10YR 5/3) moist; massive; few fine and medium granitic pebbles; slightly hard, friable; strong effervescence; moderately alkaline.

The solum is 20 to 40 inches thick. The depth to carbonates ranges from 15 to 36 inches. The mollic epipedon is 8 to 20 inches thick. The content of gravel throughout is about 5 percent, by volume.

The A horizon has value of 4 or 5 (2 or 3 moist) and chroma of 2 or 3. It is typically loam or fine sandy loam, but the range includes clay loam. The Bt horizon has value of 4 to 6 (3 to 5 moist) and chroma of 2 to 4. It is typically loam, but the range includes clay loam. The C horizon has value of 5 to 7 (4 to 6 moist) and chroma of 2 to 4. It is typically loam, but the range includes fine sandy loam, clay loam, loamy sand, or loamy fine sand.

Sully Series

The Sully series consists of very deep, well drained moderately permeable soils on uplands. These soils formed in calcareous loess. Slopes range from 6 to 60 percent.

Sully soils are commonly adjacent to Dix, Duroc, Keith, McConaughy, and Tassel soils. Dix and Tassel soils are on lower back slopes below the Sully soils. Dix soils have gravelly coarse sand above a depth of 10 inches. Duroc and Keith soils have more clay in the control section than the Sully soils. They are on very gently sloping summits above the Sully soils. Duroc soils have a mollic epipedon more than 20 inches thick. Keith soils have a mollic epipedon less than 20 inches thick. McConaughy soils have a mollic epipedon. They are in less sloping linear to concave positions below the Sully soils. Tassel soils are loamy and are shallow over bedrock.

Typical pedon of Sully loam, in an area of Sully-McConaughy complex, 9 to 30 percent slopes; 1,860 feet east and 620 feet north of the southwest corner of sec. 6, T. 13 N., R. 40 W.

A—0 to 3 inches; brown (10YR 5/3) loam, dark brown (10YR 3/3) moist; weak fine granular structure; slightly hard, friable; mildly alkaline; clear smooth boundary.

AC—3 to 18 inches; pale brown (10YR 6/3) silt loam, brown (10YR 4/3) moist; weak medium subangular blocky structure; slightly hard, friable; strong effervescence; moderately alkaline; gradual wavy boundary.

C1—18 to 40 inches; pale brown (10YR 6/3) silt loam, brown (10YR 4/3) moist; massive; slightly hard, friable; few soft accumulations of carbonate; strong effervescence; moderately alkaline; diffuse smooth boundary.

C2—40 to 60 inches; very pale brown (10YR 7/3) silt loam, brown (10YR 5/3) moist; massive; slightly hard, friable; few soft accumulations of carbonate; strong effervescence; moderately alkaline.

The depth to free carbonates is less than 5 inches.

The A horizon has value of 4 or 5 (3 or 4 moist) and chroma of 2 or 3. The AC and C horizons have value of 5 to 7 (4 to 6 moist) and chroma of 2 or 3. They are typically silt loam, but the range includes very fine sandy loam.

Tassel Series

The Tassel series consists of very shallow and shallow, somewhat excessively drained soils on uplands. Permeability is moderately rapid above the bedrock. These soils formed in material weathered from calcareous sandstone bedrock (fig. 19). Slopes range from 15 to 60 percent.

Tassel soils are commonly adjacent to Dix, Otero, Sarben, and Sully soils. Dix, Sarben, and Sully soils are on back slopes above the Tassel soils. Dix soils have very gravelly coarse sand above a depth of 10 inches. Otero, Sarben, and Sully soils are very deep. Otero soils are on colluvial foot slopes below the Tassel soils. Sully soils are silty. They formed in loess.

Typical pedon of Tassel very fine sandy loam, in an area of Tassel-Otero-Rock outcrop complex, 15 to 60 percent slopes; 1,300 feet west and 1,200 feet north of the southeast corner of sec. 24, T. 15 N., R. 41 W.

A—0 to 4 inches; grayish brown (10YR 5/2) very fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; soft, friable; slight effervescence; moderately alkaline; clear smooth boundary.

AC—4 to 7 inches; grayish brown (10YR 5/2) very fine sandy loam, dark grayish brown (10YR 4/2) moist; weak medium subangular blocky structure; soft, friable; strong effervescence; moderately alkaline; clear smooth boundary.

C—7 to 15 inches; light brownish gray (10YR 6/2) loamy very fine sand, dark grayish brown (10YR 4/2) moist; massive; hard, firm; about 10 percent medium calcareous sandstone fragments; violent

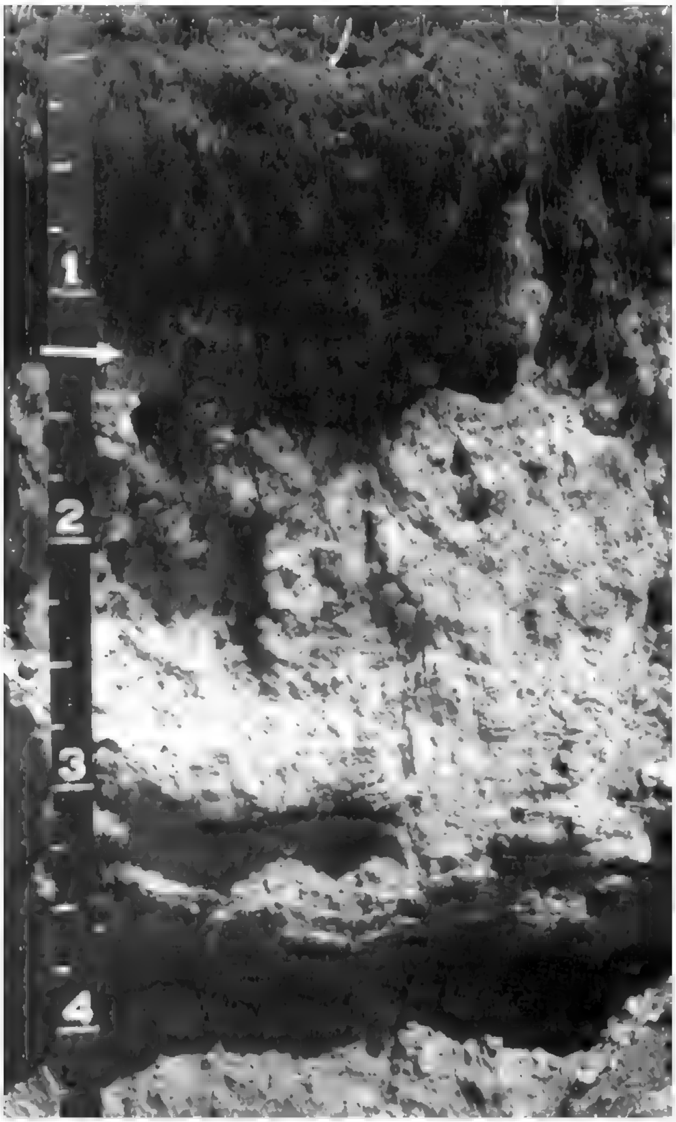

Figure 19.—A typical profile of Tassel very fine sandy loam. The arrow indicates the depth to calcareous sandstone bedrock. Depth is marked in feet.

effervescence; moderately alkaline; abrupt wavy boundary.

Cr—15 to 60 inches; very pale brown and white, calcareous sandstone bedrock; violent effervescence.

The solum is 3 to 9 inches thick. The depth to semi-consolidated bedrock ranges from 6 to 20 inches. Reaction is mildly alkaline or moderately alkaline. The content of rock fragments ranges from 2 to 15 percent.

The A horizon has value of 4 to 7 (3 to 6 moist) and chroma of 2 or 3. It is typically very fine sandy loam, but the range includes fine sandy loam. Some pedons may not have an AC horizon. The AC and C horizons have value of 5 to 8 (4 to 7 moist) and chroma of 2 or 3. They are typically very fine sandy loam and loamy very fine sand, but the range includes sandy loam.

Valent Series

The Valent series consists of very deep, excessively drained, rapidly permeable soils on dunes and hummocks in the sandhills. These soils formed in sandy eolian material. Slopes range from 0 to 60 percent.

Valent soils are commonly adjacent to Cullison, Ipage, Sarben, and Vetal soils. Cullison soils have less sand in the control section than the Valent soils. They are calcareous. They have a mollic epipedon. They are in poorly drained and very poorly drained depressions. Ipage soils are moderately well drained. They are in concave valleys below the Valent soils. Sarben and Vetal soils have more silt and clay in the control section than the Valent soils. Sarben soils are on linear or convex shoulder slopes or side slopes. Vetal soils have a mollic epipedon more than 20 inches thick. They are in swales below the Valent soils.

Typical pedon of Valent fine sand, rolling, 1,150 feet south and 200 feet west of the northeast corner of sec. 12, T. 15 N., R. 39 W.

A—0 to 6 inches; grayish brown (10YR 5/2) fine sand, dark brown (10YR 3/3) moist; weak fine granular structure parting to single grain; loose; neutral; gradual wavy boundary.

AC—6 to 11 inches; pale brown (10YR 6/3) fine sand, brown (10YR 4/3) moist; single grain; loose; neutral; gradual wavy boundary.

C—11 to 60 inches; very pale brown (10YR 7/3) fine sand, brown (10YR 5/3) moist; single grain; loose; neutral.

The solum is 3 to 17 inches thick.

The A horizon has value of 5 or 6 (3 to 5 moist) and chroma of 2 or 3. It is fine sand or loamy fine sand. The C horizon has value of 6 or 7 (5 or 6 moist) and chroma of 2 to 4. It is fine sand or sand.

Vetal Series

The Vetal series consists of very deep, well drained, moderately rapidly permeable soils in upland swales. These soils formed in sandy and loamy colluvial and eolian material. Slopes range from 0 to 3 percent.

Vetal soils are commonly adjacent to Sarben, Satanta, and Valent soils. Sarben, Satanta, and Valent soils are on summits and shoulder slopes above the Vetal soils. Sarben and Valent soils do not have a

mollic epipedon. Valent soils have more sand in the control section than the Vetal soils. Satanta soils have a mollic epipedon less than 20 inches thick. They have more clay in the control section than the Vetal soils.

Typical pedon of Vetal loamy fine sand, 0 to 3 percent slopes, 475 feet south and 2,000 feet west of the northeast corner of sec. 6, T. 12 N., R. 35 W.

Ap—0 to 8 inches; grayish brown (10YR 5/2) loamy fine sand, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; soft, very friable; neutral; abrupt smooth boundary.

A1—8 to 16 inches; dark grayish brown (10YR 4/2) very fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak fine subangular blocky structure; slightly hard, friable; neutral; clear smooth boundary.

A2—16 to 32 inches; dark gray (10YR 4/1) very fine sandy loam, very dark gray (10YR 3/1) moist; weak medium subangular blocky structure; slightly hard, friable; neutral; clear smooth boundary.

AC—32 to 38 inches; brown (10YR 5/3) very fine sandy loam, dark grayish brown (10YR 4/2) moist; weak medium subangular blocky structure; slightly hard, very friable; mildly alkaline; gradual wavy boundary.

C—38 to 60 inches; pale brown (10YR 6/3) loamy fine sand, brown (10YR 5/3) moist; massive; soft, very friable; mildly alkaline.

The solum is 24 to 60 inches thick. The mollic epipedon is 20 to 50 inches thick.

The A horizon has value of 4 or 5 (2 or 3 moist) and chroma of 1 or 2. It is typically loamy fine sand or loamy very fine sand, but the range includes fine sandy loam and very fine sandy loam. The AC horizon has value of 4 to 6 (3 or 4 moist) and chroma of 1 to 3. It is typically very fine sandy loam or loamy very fine sand. The C horizon has value of 5 to 7 (4 or 5 moist) and chroma of 2 or 3. It is typically loamy fine sand, fine sand, or sand.

Wann Series

The Wann series consists of deep, somewhat poorly drained, moderately rapid permeable soils on bottom land. These soils formed in stratified, calcareous, loamy alluvium. Slopes range from 0 to 2 percent.

Wann soils are commonly adjacent to Alda, Lex, and Norwest soils. Alda, Lex, and Norwest soils are in landscape positions similar to those of the Wann soils. Alda soils have coarse sand at a depth of 20 to 40 inches. Lex and Norwest soils have more clay in the control section than the Wann soils. Lex soils have gravelly coarse sand at a depth of 20 to 40 inches.

Typical pedon of Wann fine sandy loam, 0 to 2 percent slopes, 1,700 feet west and 1,950 feet north of the southeast corner of sec. 3, T. 13 N., R. 38 W.

Ap—0 to 7 inches; dark gray (10YR 4/1) fine sandy loam, very dark brown (10YR 2/2) moist; weak fine granular structure; soft, friable; strong effervescence; moderately alkaline; abrupt smooth boundary.

A—7 to 14 inches; dark gray (10YR 4/1) fine sandy loam, very dark gray (10YR 3/1) moist; weak medium subangular blocky structure; soft, friable; strong effervescence; moderately alkaline; clear smooth boundary.

AC—14 to 18 inches; grayish brown (10YR 5/2) fine sandy loam, dark grayish brown (10YR 4/2) moist; few fine faint dark yellowish brown (10YR 4/4) mottles; weak medium and fine subangular blocky structure; soft, friable; strong effervescence; moderately alkaline; clear smooth boundary.

C1—18 to 30 inches; stratified brown (10YR 5/3) and pale brown (10YR 6/3) loamy fine sand, dark yellowish brown (10YR4/4) and yellowish brown (10YR 5/4) moist, few fine faint brown (10YR 5/4) and common fine distinct strong brown (10YR 5/8) mottles; massive; soft, very friable; slight effervescence; mildly alkaline; abrupt smooth boundary.

C2—30 to 51 inches; stratified gray (10YR 6/1) and light brownish gray (10YR 6/2) sandy clay loam and fine sandy loam, dark gray (10YR 4/1) and grayish brown (10YR 5/2) moist; common medium distinct strong brown (10YR 5/8) mottles; massive; soft, very friable; slight effervescence; mildly alkaline; abrupt smooth boundary.

C3—51 to 60 inches; light gray (10YR 7/2) fine sand, grayish brown (10YR 5/2) moist; common medium distinct strong brown (10YR 5/6) mottles; single grain; loose; mildly alkaline.

The solum and the mollic epipedon are 8 to 20 inches thick. The depth to free carbonates ranges from 0 to 12 inches.

The A and AC horizons have value of 4 or 5 (2 or 3 moist) and chroma of 1 or 2. They are dominantly fine sandy loam, but the range includes loam and sandy loam. Reaction ranges from neutral to moderately alkaline. The C horizon has value of 5 to 7 (4 to 6 moist) and chroma of 1 to 4. It is typically stratified loamy fine sand, fine sandy loam, sandy clay loam, and fine sand. In places sand and gravelly sand are typical.

Formation of the Soils

Soil forms through processes that act on deposited or accumulated geologic material. The characteristics of the soil are determined by the physical and mineralogical composition of the parent material; the climate under which the soil material has accumulated and existed since accumulation; the plant and animal life on and in the soil; the relief, or lay of the land; and the length of time the forces of soil formation have acted on the soil material.

Climate and plant and animal life, mainly plants, are active factors of soil formation. They act on the parent material and slowly change it into a natural body that has genetically related horizons. The effects of climate and plant and animal life are conditioned by relief. The parent material affects the kind of soil that forms and, in extreme cases, determines it almost entirely. Finally, time is needed for the transformation of the parent material into a soil. Generally, a long time is required for the development of distinct horizons.

The factors of soil formation are so closely interrelated in their effects on the soil that few generalizations can be made regarding the effect of any one factor unless conditions are specified for the other factors.

Parent Material

Parent material is the unconsolidated mineral material in which a soil forms. The soils in Keith County formed in material that weathered from the underlying geologic formations or in material that was transported by wind or water.

The Ogallala Formation extends throughout most of the county. In places it is at the surface. In other places it is several hundred feet below the surface. It is composed of beds of silt, sand, gravel, caliche, and clay. Part of the Ogallala Formation is cemented by calcium carbonate. The rock thus formed ranges from friable caliche that is only partly indurated to relatively hard, resistant mortar beds that form ledges. Tassel, Rosebud, and Satanta soils formed in material that weathered from the Ogallala Formation.

Loess, or wind-deposited silty material, mantles much of the uplands in the county. It is friable, massive, and yellowish brown. It ranges from about 3.5 to several hundred feet in thickness. The deposits of loess are thicker on the western and central divides. The loess is calcareous and has a few concretions of lime. Sully, Keith, Kuma, and McConaughy soils formed in loess. Lodgepole soils, which are in potholes on uplands, formed in loess that has been modified by water.

Sandy eolian material is another major parent material in the county. It is wind-deposited material that consists mainly of quartz and feldspar minerals. The average thickness of the sandy eolian material is about 50 feet. In some places, however, it is 300 feet thick. Valent soils formed in loamy and sandy eolian material.

Colluvium is material that has been deposited by the combined forces of gravity and water. In Keith County, it is on foot slopes of hills in upland areas. Bayard, Bridget, and Duroc soils formed in colluvial material.

Alluvium is sandy to silty material that has been deposited by streams. It is on bottom land and stream terraces. Floodwater sometime deposits new sediments on the bottom land. Alda, Platte, Lex, Norwest, Gothenburg, and Wann soils formed in alluvium on bottom land.

Beds of sand and gravel beds of Pleistocene age are in some areas, mainly along the breaks of the North Platte and South Platte Rivers. They have a thin mantle of loamy water- or wind-deposited sediments. Altvan and Dix soils formed in this material.

Climate

Keith County has a semiarid climate that is characterized by light rainfall, cold winters, warm summers, high winds, and frequent changes in weather conditions. Temperatures commonly are about 90 degrees F in summer and about 20 degrees F in winter. The mean annual temperature is about 49 degrees F. The average annual precipitation is about 18 inches. The average growing season is about 136 days. The prevailing wind is from the northwest. Severe dust storms occur in spring when strong dry winds blow over unprotected soils. Tornadoes and severe thunderstorms, sometimes with hail, occur occasionally.

Because the climate is fairly uniform throughout the

county, differences in the soils are a result of the relationship between the climate and the other soil-forming factors. For example, the amount of leaching is dependent not only on the amount of precipitation in an area but also on the relief. The steeply sloping soils that are more exposed to the wind have greater runoff and evaporation and less leaching than the nearly level soils that receive the same amount of rainfall. Rain, melting snow, and wind can cause erosion, which can prevent the development of a thick surface layer, especially in the steeper areas.

Climate affects the formation of soils through its influence on the rate that rain, temperature, and wind weather and rework the parent material. Because soils form slowly when dry, soils in arid regions generally are less well developed than those in humid regions. The amount of moisture, the length of the growing season, and the prevailing temperature during the growing season affect the amount of vegetation, which is the main source of organic matter in the soils. These factors also directly affect the activity of the micro-organisms that convert organic matter to humus. Wind can remove the surface layer of the soil or can deposit a mantle of sediment on it.

Plant and Animal Life

After the parent material was deposited, bacteria, fungi, and other simple forms of plant and animal life invaded the parent material. After a time, prairie grasses began to grow and fibrous roots penetrated the soil to a depth of several feet. These roots transport water and soluble minerals, such as calcium, iron, phosphorus, nitrogen, and sulfur, to the surface, thus improving fertility. Roots also help to improve soil structure and soil aeration.

As plants decay, micro-organisms, such as bacteria, nematodes, and protozoa, act on the organic matter and decompose it into stable humus. Nitrogen-fixing bacteria in nodules on the roots of legumes remove nitrogen from the air. When these bacteria die, the nitrogen becomes available to plants. Fungi and small animals, such as millipedes, spiders, and mites, also act on organic matter and help decompose it into humus. Earthworms, insects, and small burrowing animals mix the soil material with organic matter. This activity speeds soil development and increases friability.

As decayed organic matter accumulates, the color of the surface layer becomes darker and the physical and chemical characteristics of the surface layer change. The decaying organic matter adds nutrients to the soil, improves tilth and permeability, and increases the rate of water infiltration. In Keith County, the content of organic matter is moderate in the Duroc and Kuma soils and low in the Sarben and Valent soils.

Relief

Relief influences soil formation mainly through its effect on drainage, runoff, and plant growth. The slope, the shape of the surface, and the permeability of the soil determine the rate of runoff, the internal drainage, and the moisture content of the soil. Internal drainage and availability of moisture are important factors in the development of soil horizons.

The nearly level to gently sloping soils on uplands are more strongly developed and have more distinct horizons than the steeper soils. They absorb more moisture and water percolates deeper into the profile. Consequently, more lime and plant nutrients are leached in these soils and well developed horizons form. The nearly level Kuma soils and the nearly level and gently sloping Satanta soils have distinct horizons.

In the steeper areas where runoff is rapid and little moisture penetrates the soil, erosion removes the surface soil almost as fast as it forms. Lime and other elements are not leached to so great a depth as they are in the less sloping soils. In Keith County, the steep and very steep Sully soils show little profile development other than a thin, slightly darkened surface layer.

The nearly level soils on bottom land receive runoff from the higher surrounding areas. These soils are somewhat poorly drained because of slow runoff or a moderately high water table. In areas where the water table is moderately high, capillary action brings moisture from the saturation zone to the root zone. The amount of moisture in the soil affects the kind and amount of vegetation, which influences soil development. Lex, Norwest, Alda, Platte, and Wann soils are somewhat poorly drained.

Because of differences in relief, some processes of horizon differentiation are slower and other processes are accelerated. Generally, soils that have gentle slopes have a thick solum and distinct horizons. Soils that have steep slopes have a thinner solum and less distinct horizons.

Time

Time is required for the formation of a mature soil. Mature soils have a thick, dark surface layer and a distinct subsoil. In Keith County, Kuma and Satanta soils are mature soils with well expressed horizons.

Most of the soils on bottom land do not have well developed horizons because new deposits of alluvium are made before soil development can take place. The upland soils that have moderately steep slopes have

been in place long enough for horizons to form. Because of the slope, however, soil material erodes before well defined horizons can form. Lex and Wann soils are immature soils on bottom land. Sully and Valent soils are immature soils on uplands.

The degree of profile development depends on the intensity of the soil-forming factors, the length of time that the factors have been active, and the nature of the parent material. Differences in the length of time that geologic material has been in place are commonly proportional to the degree of horizon distinction.

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Glossary

ABC soil. A soil having an A, a B, and a C horizon.

AC soil. A soil having only an A and a C horizon. Commonly, such soil formed in recent alluvium or on steep, rocky slopes.

Aeration, soil. The exchange of air in soil with air from the atmosphere. The air in a well aerated soil is similar to that in the atmosphere; the air in a poorly aerated soil is considerably higher in carbon dioxide and lower in oxygen.

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates, such as granules, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

Alkali (sodic) soil. A soil having so high a degree of alkalinity (pH 8.5 or higher) or so high a percentage of exchangeable sodium (15 percent or more of the total exchangeable bases), or both, that plant growth is restricted.

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Area reclaim (in tables). An area difficult to reclaim after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

Association, soil. A group of soils geographically associated in a characteristic repeating pattern and defined and delineated as a single map unit.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as:

Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	9 to 12
Very high	more than 12

Base saturation. The degree to which material having cation-exchange properties is saturated with exchangeable bases (sum of Ca, Mg, Na, K), expressed as a percentage of the total cation-exchange capacity.

Bedding planes. Fine stratifications, less than 5 millimeters thick, in unconsolidated alluvial, eolian, lacustrine, or marine sediments.

Bedding system. A drainage system made by plowing, grading, or otherwise shaping the surface of a flat field. It consists of a series of low ridges separated by shallow, parallel dead furrows.

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Blowout. A shallow depression from which all or most of the soil material has been removed by the wind. A blowout has a flat or irregular floor formed by a resistant layer or by an accumulation of pebbles or cobbles. In some blowouts the water table is exposed.

Bottom land. The normal flood plain of a stream, subject to flooding.

Calcareous soil. A soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.

Caliche. A more or less cemented deposit of calcium carbonate in soils of warm-temperate, subhumid to arid areas. Caliche occurs as soft, thin layers in the soil or as hard, thick beds just beneath the solum, or it is exposed at the surface by erosion.

Capillary water. Water held as a film around soil particles and in tiny spaces between particles. Surface tension is the adhesive force that holds capillary water in the soil.

Cation-exchange capacity. The total amount of exchangeable cations that can be held by the soil, expressed in terms of milliequivalents per 100 grams of soil at neutrality (pH 7.0) or at some other stated pH value. The term, as applied to soils, is synonymous with base-exchange capacity but is more precise in meaning.

Catsteps. Very small, irregular terraces on steep hillsides, especially in pasture, formed by the

trampling of cattle or the slippage of saturated soil.

Chiseling. Tillage with an implement having one or more soil-penetrating points that shatter or loosen hard, compacted layers to a depth below normal plow depth.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay skin.

Claypan. A slowly permeable soil horizon that contains much more clay than the horizons above it. A claypan is commonly hard when dry and plastic or stiff when wet.

Climax vegetation. The stabilized plant community on a particular site. The plant cover reproduces itself and does not change so long as the environment remains the same.

Coarse fragments. If round, mineral or rock particles 2 millimeters to 25 centimeters (10 inches) in diameter; if flat, mineral or rock particles (flagstone) 15 to 38 centimeters (6 to 15 inches) long.

Coarse textured soil. Sand or loamy sand.

Colluvium. Soil material, rock fragments, or both moved by creep, slide, or local wash and deposited at the base of steep slopes.

Complex, soil. A map unit of two or more kinds of soil in such an intricate pattern or so small in area that it is not practical to map them separately at the selected scale of mapping. The pattern and proportion of the soils are somewhat similar in all areas.

Conservation tillage. A tillage system that does not invert the soil and that leaves a protective amount of crop residue on the surface throughout the year.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are:

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard; little affected by moistening.

Contour stripcropping. Growing crops in strips that follow the contour. Strips of grass or close-growing crops are alternated with strips of clean-tilled crops or summer fallow.

Control section. The part of the soil on which classification is based. The thickness varies among different kinds of soil, but for many it is that part of the soil profile between depths of 10 inches and 40 or 80 inches.

Cover crop. A close-growing crop grown primarily to improve and protect the soil between periods of regular crop production, or a crop grown between trees and vines in orchards and vineyards.

Cutbanks cave (in tables). The walls of excavations tend to cave in or slough.

Decreasers. The most heavily grazed climax range plants. Because they are the most palatable, they are the first to be destroyed by overgrazing.

Deferred grazing. Postponing grazing or resting grazing land for a prescribed period.

Depth to rock (in tables). Bedrock is too near the surface for the specified use.

Drainage class (natural). Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:

Excessively drained.—Water is removed from the soil very rapidly. Excessively drained soils are commonly very coarse textured, rocky, or shallow. Some are steep. All are free of the mottling related to wetness.

Somewhat excessively drained.—Water is removed from the soil rapidly. Many somewhat excessively drained soils are sandy and rapidly pervious. Some are shallow. Some are so steep that much of the water they receive is lost as runoff. All are free of the mottling related to wetness.

Well drained.—Water is removed from the soil readily, but not rapidly. It is available to plants

throughout most of the growing season, and wetness does not inhibit growth of roots for significant periods during most growing seasons. Well drained soils are commonly medium textured. They are mainly free of mottling.

Moderately well drained.—Water is removed from the soil somewhat slowly during some periods. Moderately well drained soils are wet for only a short time during the growing season, but periodically they are wet long enough that most mesophytic crops are affected. They commonly have a slowly pervious layer within or directly below the solum or periodically receive high rainfall, or both.

Somewhat poorly drained.—Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of mesophytic crops unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly pervious layer, a high water table, additional water from seepage, nearly continuous rainfall, or a combination of these.

Poorly drained.—Water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long periods. Free water is commonly at or near the surface for long enough during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.

Very poorly drained.—Water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most mesophytic crops cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly continuous, they can have moderate or high slope gradients.

Drainage, surface. Runoff, or surface flow of water, from an area.

Eolian soil material. Earthy parent material accumulated through wind action; commonly refers to sandy material in dunes or to loess in blankets on the surface.

Erosion. The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.

Erosion (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.

Erosion (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of the activities of man or other animals or of a catastrophe in nature, for example, fire, that exposes the surface.

Excess fines (in tables). Excess silt and clay in the soil. The soil is not a source of gravel or sand for construction purposes.

Fallow. Cropland left idle in order to restore productivity through accumulation of moisture. Summer fallow is common in regions of limited rainfall where cereal grains are grown. The soil is tilled for at least one growing season for weed control and decomposition of plant residue.

Fast intake (in tables). The rapid movement of water into the soil.

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Fibric soil material (peat). The least decomposed of all organic soil material. Peat contains a large amount of well preserved fiber that is readily identifiable according to botanical origin. Peat has the lowest bulk density and the highest water content at saturation of all organic soil material.

Field moisture capacity. The moisture content of a soil, expressed as a percentage of the ovendry weight, after the gravitational, or free, water has drained away; the field moisture content 2 or 3 days after a soaking rain; also called *normal field capacity, normal moisture capacity,* or *capillary capacity.*

Fine textured soil. Sandy clay, silty clay, or clay.

First bottom. The normal flood plain of a stream, subject to frequent or occasional flooding.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Foot slope. The inclined surface at the base of a hill.

Forb. Any herbaceous plant not a grass or a sedge.

Frost action (in tables). Freezing and thawing of soil moisture. Frost action can damage roads, buildings and other structures, and plant roots.

Genesis, soil. The mode of origin of the soil. Refers especially to the processes or soil-forming factors responsible for the formation of the solum, or true soil, from the unconsolidated parent material.

Gleyed soil. Soil that formed under poor drainage, resulting in the reduction of iron and other

elements in the profile and in gray colors and mottles.

Grassed waterway. A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

Gravel. Rounded or angular fragments of rock up to 3 inches (2 millimeters to 7.6 centimeters) in diameter. An individual piece is a pebble.

Ground water (geology). Water filling all the unblocked pores of the material below the water table.

Gully. A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rainfall. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage.

Hemic soil material (mucky peat). Organic soil material intermediate in degree of decomposition between the less decomposed fibric and the more decomposed sapric material.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an uppercase letter represents the major horizons. Numbers or lowercase letters that follow represent subdivisions of the major horizons. The major horizons are as follows:

O horizon.—An organic layer of fresh and decaying plant residue.

A horizon.—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, any plowed or disturbed surface layer.

E horizon.—The mineral horizon in which the main feature is loss of silicate clay, iron, aluminum, or some combination of these.

B horizon.—The mineral horizon below an O, A, or E horizon. The B horizon is in part a layer of transition from the overlying horizon to the underlying C horizon. The B horizon also has distinctive characteristics, such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) granular, prismatic, or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these.

C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the overlying horizon. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, an Arabic numeral, commonly a 2, precedes the letter C.

Cr horizon.—Soft, consolidated bedrock beneath the soil.

R layer.—Hard, consolidated bedrock beneath the soil. The bedrock commonly underlies a C horizon but can be directly below an A or a B horizon.

Hydrologic soil groups. Refers to soils grouped according to their runoff-producing characteristics. The chief consideration is the inherent capacity of soil bare of vegetation to permit infiltration. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff. Soils are assigned to four groups. In group A are soils having a high infiltration rate when thoroughly wet and having a low runoff potential. They are mainly deep, well drained, and sandy or gravelly. In group D, at the other extreme, are soils having a very slow infiltration rate and thus a high runoff potential. They have a claypan or clay layer at or near the surface, have a permanent high water table, or are shallow over nearly impervious bedrock or other material. A soil is assigned to two hydrologic groups if part of the acreage is artificially drained and part is undrained.

Increasers. Species in the climax vegetation that increase in amount as the more desirable plants are reduced by close grazing. Increasers commonly are the shorter plants and are less palatable to livestock.

Infiltration. The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

Infiltration capacity. The maximum rate at which water can infiltrate into a soil under a given set of conditions.

Infiltration rate. The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

Intake rate. The average rate of water entering the soil under irrigation. Most soils have a fast initial rate; the rate decreases with application time. Therefore, intake rate for design purposes is not a constant but is a variable depending on the net irrigation application. The rate of water intake, in inches per hour, is expressed as follows:

Less than 0.2	very low
0.2 to 0.4	low

0.4 to 0.75	moderately low
0.75 to 1.25	moderate
1.25 to 1.75	moderately high
1.75 to 2.5	high
More than 2.5	very high

Invaders. On range, plants that encroach into an area and grow after the climax vegetation has been reduced by grazing. Generally, invader plants follow disturbance of the surface.

Irrigation. Application of water to soils to assist in production of crops. Methods of irrigation are:
Basin.—Water is applied rapidly to nearly level plains surrounded by levees or dikes.
Border.—Water is applied at the upper end of a strip in which the lateral flow of water is controlled by small earth ridges called border dikes, or borders.
Controlled flooding.—Water is released at intervals from closely spaced field ditches and distributed uniformly over the field.
Corrugation.—Water is applied to small, closely spaced furrows or ditches in fields of close-growing crops or in orchards so that it flows in only one direction.
Drip (or trickle).—Water is applied slowly and under low pressure to the surface of the soil or into the soil through such applicators as emitters, porous tubing, or perforated pipe.
Furrow.—Water is applied in small ditches made by cultivation implements. Furrows are used for tree and row crops.
Sprinkler.—Water is sprayed over the soil surface through pipes or nozzles from a pressure system.
Subirrigation.—Water is applied in open ditches or tile lines until the water table is raised enough to wet the soil.
Wild flooding.—Water, released at high points, is allowed to flow onto an area without controlled distribution.

Landslide. The rapid downhill movement of a mass of soil and loose rock, generally when wet or saturated. The speed and distance of movement, as well as the amount of soil and rock material, vary greatly.

Leaching. The removal of soluble material from soil or other material by percolating water.

Liquid limit. The moisture content at which the soil passes from a plastic to a liquid state.

Loam. Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Loess. Fine grained material, dominantly of silt-sized particles, deposited by the wind.

Low strength. The soil is not strong enough to support loads.

Medium textured soil. Very fine sandy loam, loam, silt loam, or silt.

Mineral soil. Soil that is mainly mineral material and low in organic material. Its bulk density is more than that of organic soil.

Minimum tillage. Only the tillage essential to crop production and prevention of soil damage.

Miscellaneous area. An area that has little or no natural soil and supports little or no vegetation.

Moderately coarse textured soil. Coarse sandy loam, sandy loam, or fine sandy loam.

Moderately fine textured soil. Clay loam, sandy clay loam, or silty clay loam.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

Mottling, soil. Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded drainage. Descriptive terms are as follows: abundance—*few, common,* and *many*; size—*fine, medium,* and *coarse*; and contrast—*faint, distinct,* and *prominent.* The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium,* from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse,* more than 15 millimeters (about 0.6 inch).

Munsell notation. A designation of color by degrees of three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color with hue of 10YR, value of 6, and chroma of 4.

Neutral soil. A soil having a pH value between 6.6 and 7.3. (See Reaction, soil.)

Organic matter. Plant and animal residue in the soil in various stages of decomposition.

Parent material. The unconsolidated organic and mineral material in which soil forms.

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedon. The smallest volume that can be called "a soil." A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percolation. The downward movement of water through the soil.

Percs slowly (in tables). The slow movement of water

through the soil, adversely affecting the specified use.

Permeability. The quality of the soil that enables water to move downward through the profile. Permeability is measured as the number of inches per hour that water moves downward through the saturated soil. Terms describing permeability are:

Very slow	less than 0.06 inch
Slow	0.06 to 0.2 inch
Moderately slow	0.2 to 0.6 inch
Moderate	0.6 inch to 2.0 inches
Moderately rapid	2.0 to 6.0 inches
Rapid	6.0 to 20 inches
Very rapid	more than 20 inches

Phase, soil. A subdivision of a soil series based on features that affect its use and management, such as slope, stoniness, and thickness.

pH value. A numerical designation of acidity and alkalinity in soil. (See Reaction, soil.)

Piping (in tables). Formation of subsurface tunnels or pipelike cavities by water moving through the soil.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Plastic limit. The moisture content at which a soil changes from semisolid to plastic.

Ponding. Standing water on soils in closed depressions. Unless the soils are artificially drained, the water can be removed only by percolation or evapotranspiration.

Poor filter (in tables). Because of rapid permeability, the soil may not adequately filter effluent from a waste disposal system.

Poorly graded. Refers to a coarse grained soil or soil material consisting mainly of particles of nearly the same size. Because there is little difference in size of the particles, density can be increased only slightly by compaction.

Productivity, soil. The capability of a soil for producing a specified plant or sequence of plants under specific management.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Range condition. The present composition of the plant community on a range site in relation to the potential natural plant community for that site. Range condition is expressed as excellent, good, fair, or poor, on the basis of how much the present plant community has departed from the potential.

Rangeland. Land on which the potential natural vegetation is predominantly grasses, grasslike plants, forbs, or shrubs suitable for grazing or browsing. It includes natural grasslands, savannas, many wetlands, some deserts, tundras, and areas that support certain forb and shrub communities.

Range site. An area of rangeland where climate, soil, and relief are sufficiently uniform to produce a distinct natural plant community. A range site is the product of all the environmental factors responsible for its development. It is typified by an association of species that differ from those on other range sites in kind or proportion of species or total production.

Reaction, soil. A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degrees of acidity or alkalinity, expressed as pH values, are:

Extremely acid	below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Medium acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Mildly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Relief. The elevations or inequalities of a land surface, considered collectively.

Rill. A steep-sided channel resulting from accelerated erosion. A rill is generally a few inches deep and not wide enough to be an obstacle to farm machinery.

Rooting depth (in tables). Shallow root zone. The soil is shallow over a layer that greatly restricts roots.

Root zone. The part of the soil that can be penetrated by plant roots.

Runoff. The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Saline soil. A soil containing soluble salts in an amount that impairs growth of plants. A saline soil does not contain excess exchangeable sodium.

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Sandstone. Sedimentary rock containing dominantly sand-sized particles.

Sapric soil material (muck). The most highly decomposed of all organic soil material. Muck has

the least amount of plant fiber, the highest bulk density, and the lowest water content at saturation of all organic soil material.

Seepage (in tables). The movement of water through the soil. Seepage adversely affects the specified use.

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer or of the underlying material. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

Sheet erosion. The removal of a fairly uniform layer of soil material from the land surface by the action of rainfall and surface runoff.

Shrink-swell. The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Slick spot. A small area of soil having a puddled, crusted, or smooth surface and an excess of exchangeable sodium. The soil is generally silty or clayey, is slippery when wet, and is low in productivity.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance. In this survey the classes of slope are:

Nearly level	0 to 2 percent
Very gently sloping	1 to 3 percent
Gently sloping	3 to 6 percent
Strongly sloping	6 to 9 percent
Rolling	9 to 24 percent
Moderately steep	9 to 20 percent
Steep	9 to 30 percent
Hilly	more than 24 percent
Very steep	30 to 60 percent

Slope (in tables). Slope is great enough that special practices are required to ensure satisfactory performance of the soil for a specific use.

Slow refill (in tables). The slow filling of ponds, resulting from restricted permeability in the soil.

Small stones (in tables). Rock fragments less than 3 inches (7.6 centimeters) in diameter. Small stones adversely affect the specified use of the soil.

Soil. A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A, E, and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and plant and animal activities are largely confined to the solum.

Stripcropping. Growing crops in a systematic arrangement of strips or bands which provide vegetative barriers to soil blowing and water erosion.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are either *single grain* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

Stubble mulch. Stubble or other crop residue left on the soil or partly worked into the soil. It protects the soil from soil blowing and water erosion after harvest, during preparation of a seedbed for the next crop, and during the early growing period of the new crop.

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Subsurface layer. Any surface soil horizon (A, E, AB, or EB) below the surface layer.

Summer fallow. The tillage of uncropped land during the summer to control weeds and allow storage of moisture in the soil for the growth of a later crop. A practice common in semiarid regions, where annual precipitation is not enough to produce a crop every year. Summer fallow is frequently practiced before planting winter grain.

Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from about 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Surface soil. The A, E, AB, and EB horizons. It includes all subdivisions of these horizons.

Taxadjuncts. Soils that cannot be classified in a series recognized in the classification system. Such soils are named for a series they strongly resemble and are designated as taxadjuncts to that series because they differ in ways too small to be of

consequence in interpreting their use and behavior.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that water soaks into the soil or flows slowly to a prepared outlet.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay.* The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Thin layer (in tables). A layer of otherwise suitable soil material that is too thin for the specified use.

Tilth, soil. The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

Too arid (in tables). The soil is dry most of the time, and vegetation is difficult to establish.

Topsoil. The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Well graded. Refers to soil material consisting of coarse grained particles that are well distributed over a wide range in size or diameter. Such soil normally can be easily increased in density and bearing properties by compaction. Contrasts with poorly graded soil.

Tables

TABLE 1.--TEMPERATURE AND PRECIPITATION

(Recorded in the period 1951-81 at Ogallala, Nebraska)

Month	Temperature						Precipitation				
	Average daily maximum	Average daily minimum	Average	2 years in 10 will have-- Maximum temperature higher than--	2 years in 10 will have-- Minimum temperature lower than--	Average number of growing degree days*	Average	2 years in 10 will have-- Less than--	2 years in 10 will have-- More than--	Average number of days with 0.10 inch or more	Average snowfall
	°F	°F	°F	°F	°F	Units	In	In	In		In
January-----	36.6	10.3	73.5	64	-17	0	0.42	0.09	0.68	2	5.4
February----	42.6	15.5	29.1	73	-14	10	.46	.07	.75	2	5.6
March-------	48.8	22.4	35.6	81	-6	20	1.12	.35	1.74	3	8.7
April-------	62.1	34.0	48.1	88	12	74	1.81	.85	2.63	4	1.4
May---------	71.6	44.8	58.2	94	27	267	3.46	1.66	5.00	7	.4
June--------	82.5	54.6	68.6	104	38	558	3.05	1.58	4.33	7	.0
July--------	90.0	60.3	75.2	105	46	781	2.66	1.29	3.84	6	.0
August------	88.1	57.7	72.9	103	43	710	1.80	.72	2.71	4	.0
September---	78.3	46.6	62.5	99	27	382	1.41	.24	2.31	3	.0
October-----	67.1	34.1	50.6	90	17	116	.76	.22	1.20	2	.1
November----	50.3	21.9	36.1	77	0	6	.52	.08	.85	2	3.0
December----	40.7	14.2	27.5	67	-14	0	.45	.12	.72	2	4.1
Yearly:											
Average---	63.2	34.7	49.0	---	---	---	---	---	---	---	---
Extreme---	---	---	---	106	-19	---	---	---	---	---	---
Total-----	---	---	---	---	---	2,924	17.92	13.82	21.79	44	28.7

* A growing degree day is a unit of heat available for plant growth. It can be calculated by adding the maximum and minimum daily temperatures, dividing the sum by 2, and subtracting the temperature below which growth is minimal for the principal crops in the area (50 degrees F).

TABLE 2.--FREEZE DATES IN SPRING AND FALL

(Recorded in the period 1951-81 at Ogallala, Nebraska)

Probability	Temperature		
	24 °F or lower	28 °F or lower	32 °F or lower
Last freezing temperature in spring:			
1 year in 10 later than--	Apr. 29	May 11	May 21
2 years in 10 later than--	Apr. 24	May 6	May 16
5 years in 10 later than--	Apr. 14	Apr. 27	May 7
First freezing temperature in fall:			
1 year in 10 earlier than--	Oct. 5	Sept. 18	Sept. 15
2 years in 10 earlier than--	Oct. 10	Sept. 24	Sept. 20
5 years in 10 earlier than--	Oct. 20	Oct. 5	Sept. 30

TABLE 3.--GROWING SEASON

(Recorded in the period 1951-81 at Ogallala, Nebraska)

Probability	Daily minimum temperature during growing season		
	Higher than 24 °F	Higher than 28 °F	Higher than 32 °F
	Days	Days	Days
9 years in 10	167	138	125
8 years in 10	174	145	132
5 years in 10	188	160	145
2 years in 10	202	175	159
1 year in 10	210	183	166

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map symbol	Soil name	Acres	Percent
Ad	Alda fine sandy loam, 0 to 2 percent slopes	4,240	0.6
AwF	Altvan-Dix complex, 6 to 30 percent slopes	8,400	1.2
Bb	Bankard sand, 0 to 2 percent slopes	1,085	0.2
Bc	Bankard loamy sand, 0 to 2 percent slopes	1,650	0.2
Bd	Bankard loamy sand, channeled	3,790	0.5
BeB	Bayard very fine sandy loam, 1 to 3 percent slopes	19,450	2.7
Bo	Boel loamy fine sand, 0 to 2 percent slopes	3,640	0.5
Bs	Bridget silt loam, 0 to 1 percent slopes	4,940	0.7
BtB	Bridget loam, 1 to 3 percent slopes	1,810	0.3
ChB	Chappell fine sandy loam, 0 to 3 percent slopes	2,430	0.3
Cu	Cullison fine sandy loam, 0 to 2 percent slopes	1,110	0.2
Cz	Cullison loam, wet, 0 to 2 percent slopes	890	0.1
DfE	Dix gravelly loam, 3 to 20 percent slopes	4,220	0.6
DsG	Dix-Sully-Sarben complex, 20 to 60 percent slopes	9,040	1.3
Dt	Duroc loam, terrace, 0 to 1 percent slopes	9,820	1.4
DtB	Duroc loam, terrace, 1 to 3 percent slopes	2,270	0.3
Du	Duroc silt loam, 0 to 1 percent slopes	3,900	0.5
DuB	Duroc silt loam, 1 to 3 percent slopes	18,130	2.6
Fu	Fluvaquents, sandy	620	0.1
Go	Gothenburg loamy sand, 0 to 2 percent slopes	11,635	1.6
IpB	Ipage fine sand, 0 to 3 percent slopes	10,650	1.5
Ja	Janise loam, 0 to 2 percent slopes	3,210	0.5
Jd	Janise loam, drained, 0 to 2 percent slopes	1,530	0.2
KeB	Keith loam, 1 to 3 percent slopes	10,670	1.5
KeC	Keith loam, 3 to 6 percent slopes	8,490	1.2
Ku	Kuma loam, 0 to 1 percent slopes	14,790	2.1
KuB	Kuma loam, 1 to 3 percent slopes	37,450	5.3
La	Lawet loam, 0 to 2 percent slopes	2,250	0.3
Le	Lex loam 0 to 2 percent slopes	6,510	0.9
Lp	Lodgepole silt loam, 0 to 1 percent slopes	2,080	0.3
Ma	Marlake fine sandy loam, 0 to 1 percent slopes	370	0.1
Me	Merrick loam, 0 to 2 percent slopes	3,520	0.5
No	Norwest loam, 0 to 2 percent slopes	5,350	0.8
Pp	Pits and dumps	340	*
Pt	Platte loam, 0 to 2 percent slopes	1,280	0.2
RtB	Rosebud loam, 1 to 3 percent slopes	2,160	0.3
RtD	Rosebud loam, 3 to 9 percent slopes	910	0.1
SaB	Sarben loamy fine sand, 0 to 3 percent slopes	960	0.1
SaC	Sarben loamy fine sand, 3 to 6 percent slopes	11,500	1.6
SaD	Sarben loamy fine sand, 6 to 9 percent slopes	11,750	1.7
SaE	Sarben loamy fine sand, 9 to 20 percent slopes	7,630	1.1
Sb	Satanta loam, 0 to 1 percent slopes	1,050	0.1
SbB	Satanta loam, 1 to 3 percent slopes	30,900	4.4
SbC	Satanta loam, 3 to 6 percent slopes	19,070	2.7
ScD	Satanta-Dix complex, 3 to 9 percent slopes	6,560	0.9
SfD	Sully loam, 6 to 9 percent slopes	5,740	0.8
SfG	Sully loam, 30 to 60 percent slopes	21,630	3.0
SkE	Sully-Dix complex, 9 to 20 percent slopes	3,380	0.5
SmE2	Sully-McConaughy complex, 9 to 20 percent slopes, eroded	4,430	0.6
SmF	Sully-McConaughy complex, 9 to 30 percent slopes	24,460	3.4
TaG	Tassel-Otero-Rock outcrop complex, 15 to 60 percent slopes	9,640	1.4
VdB	Valent fine sand, 0 to 3 percent slopes	1,620	0.2
VdD	Valent fine sand, 3 to 9 percent slopes	43,430	6.1
VdE	Valent fine sand, rolling	100,310	14.1
VdF	Valent fine sand, rolling and hilly	116,214	16.4
VgG	Valent fine sand, gullied, 30 to 60 percent slopes	1,220	0.2
VtG	Valent-Tassel-Rock outcrop complex, 9 to 60 percent slopes	3,770	0.5
VwB	Vetal loamy fine sand, 0 to 3 percent slopes	11,290	1.6
Wa	Wann fine sandy loam, 0 to 2 percent slopes	3,850	0.5
	Water	45,250	6.4
	Total	710,284	100.0

* Less than 0.1 percent.

TABLE 5.--PRIME FARMLAND

(Only the soils considered prime farmland are listed. Urban or built-up areas of the soils listed are not considered prime farmland. If a soil is prime farmland only under certain conditions, the conditions are specified in parentheses after the soil name)

Map symbol	Soil name
BaB	Bayard very fine sandy loam, 1 to 3 percent slopes
Bs	Bridget silt loam, 0 to 1 percent slopes (where irrigated)
BtB	Bridget loam, 1 to 3 percent slopes (where irrigated)
ChB	Chappell fine sandy loam, 0 to 3 percent slopes (where irrigated)
Dt	Duroc loam, terrace, 0 to 1 percent slopes (where irrigated)
DtB	Duroc loam, terrace, 1 to 3 percent slopes (where irrigated)
Du	Duroc silt loam, 0 to 1 percent slopes (where irrigated)
DuB	Duroc silt loam, 1 to 3 percent slopes (where irrigated)
KeB	Keith loam, 1 to 3 percent slopes (where irrigated)
KeC	Keith loam, 3 to 6 percent slopes (where irrigated)
Ku	Kuma loam, 0 to 1 percent slopes (where irrigated)
KuB	Kuma loam, 1 to 3 percent slopes (where irrigated)
Le	Lex loam, 0 to 2 percent slopes (where drained)
Me	Merrick loam, 0 to 2 percent slopes (where irrigated)
No	Norwest loam, 0 to 2 percent slopes (where drained)
RtB	Rosebud loam, 1 to 3 percent slopes (where irrigated)
Sb	Satanta loam, 0 to 1 percent slopes (where irrigated)
SbB	Satanta loam, 1 to 3 percent slopes (where irrigated)
SbC	Satanta loam, 3 to 6 percent slopes (where irrigated)
Wa	Wann fine sandy loam, 0 to 2 percent slopes (where irrigated)

TABLE 6.--LAND CAPABILITY AND YIELDS PER ACRE OF CROPS

(Yields in the N columns are for nonirrigated soils; those in the I columns are for irrigated soils. Yields are those that can be expected under a high level of management. Absence of a yield indicates that the soil is not suited to the crop or the crop generally is not grown on the soil)

Soil name and map symbol	Land capability		Alfalfa	Dry beans	Corn	Winter wheat
	N	I	I	I	I	N
			Tons	Bu	Bu	Bu
Ad-------------------Alda	IIIw	IIIw	5.0	22	120	28
AwF------------------Altvan-Dix	VIe	---	---	---	---	---
Bb-------------------Bankard	VIs	---	---	---	---	---
Bc-------------------Bankard	IVe	IVe	2.5	---	95	24
Bd-------------------Bankard	VIw	---	---	---	---	---
BeB------------------Bayard	IIe	IIe	5.0	26	135	34
Bo-------------------Boel	IVw	IVw	3.8	---	80	---
Bs-------------------Bridget	IIc	I	6.2	30	150	44
BtB------------------Bridget	IIe	IIe	5.8	28	145	40
ChB------------------Chappell	IIIe	IIIe	4.5	24	130	30
Cu, Cz---------------Cullison	Vw	---	---	---	---	---
DfE------------------Dix	VIs	---	---	---	---	---
DsG------------------Dix-Sully-Sarben	VIIs	---	---	---	---	---
Dt-------------------Duroc	IIc	I	6.0	32	155	46
DtB------------------Duroc	IIe	IIe	5.8	30	150	42
Du-------------------Duroc	IIc	I	6.0	32	155	46
DuB------------------Duroc	IIe	IIe	5.8	30	150	42
Fu*------------------Fluvaquents	VIIIw	---	---	---	---	---

See footnote at end of table.

TABLE 6.--LAND CAPABILITY AND YIELDS PER ACRE OF CROPS--Continued

Soil name and map symbol	Land capability		Alfalfa	Dry beans	Corn	Winter wheat
	N	I	I	I	I	N
			Tons	Bu	Bu	Bu
Go------------------ Gothenburg	VIIs	---	---	---	---	---
IpB----------------- Ipage	VIe	IVe	3.9	---	110	---
Ja------------------ Janise	VIs	---	---	---	---	---
Jd------------------ Janise	VIs	IVs	3.6	27	90	---
KeB----------------- Keith	IIe	IIe	5.6	28	145	40
KeC----------------- Keith	IIIe	IIIe	5.0	24	135	32
Ku------------------ Kuma	IIc	I	6.0	34	155	46
KuB----------------- Kuma	IIe	IIe	5.8	30	150	42
La------------------ Lawet	Vw	---	---	---	---	---
Le------------------ Lex	IIIw	IIIw	5.5	---	130	32
Lp------------------ Lodgepole	IIIw	IVw	3.8	25	90	20
Ma------------------ Marlake	VIIIw	---	---	---	---	---
Me------------------ Merrick	IIc	I	6.2	34	150	44
No------------------ Norwest	IIIw	IIIw	6.0	32	140	40
Pp*----------------- Pits and dumps	VIIIs	---	---	---	---	---
Pt------------------ Platte	VIw	IVw	3.6	20	80	---
RtB----------------- Rosebud	IIIe	IIIe	5.1	20	125	30
RtD----------------- Rosebud	IVe	IVe	3.6	25	120	26
SaB----------------- Sarben	IVe	IIIe	3.4	---	115	28
SaC----------------- Sarben	IVe	IVe	3.4	---	110	26

See footnote at end of table.

TABLE 6.--LAND CAPABILITY AND YIELDS PER ACRE OF CROPS--Continued

Soil name and map symbol	Land capability		Alfalfa	Dry beans	Corn	Winter wheat
	N	I	I	I	I	N
			Tons	Bu	Bu	Bu
SaD------------------ Sarben	VIe	IVe	3.2	---	105	---
SaE------------------ Sarben	VIe	---	---	---	---	---
Sb------------------- Satanta	IIc	I	6.0	30	150	44
SbB------------------ Satanta	IIe	IIe	5.6	28	145	40
SbC------------------ Satanta	IIIe	IIIe	5.0	24	135	32
ScD------------------ Satanta-Dix	IVe	IVe	3.6	24	120	28
SfD------------------ Sully	IVe	IVe	3.0	---	110	28
SfG------------------ Sully	VIIe	---	---	---	---	---
SkE------------------ Sully-Dix	VIe	---	---	---	---	---
SmE2, SmF------------ Sully-McConaughy	VIe	---	---	---	---	---
TaG*----------------- Tassel-Otero-Rock outcrop	VIIs	---	---	---	---	---
VdB------------------ Valent	VIe	IVe	3.5	---	95	---
VdD------------------ Valent	VIe	IVe	3.0	---	90	---
VdE------------------ Valent	VIe	---	---	---	---	---
VdF------------------ Valent-Valent	VIIe	---	---	---	---	---
VgG------------------ Valent	VIIe	---	---	---	---	---
VtG*----------------- Valent-Tassel-Rock outcrop	VIIs	---	---	---	---	---
VwB------------------ Vetal	IIIe	IIIe	5.0	20	120	28
Wa------------------- Wann	IIw	IIw	5.8	26	135	38

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 7.--CAPABILITY CLASSES AND SUBCLASSES

(All soils are assigned to nonirrigated capability subclasses (N). Only potentially irrigable soils are assigned to irrigated subclasses (I). Miscellaneous areas are excluded. Absence of an entry indicates no acreage)

Class	Total acreage	Major management concerns (Subclass) Erosion (e)	Wetness (w)	Soil problem (s)	Climate (c)
		Acres	Acres	Acres	Acres
I (N)	---	---	---	---	---
(I)	38,020	---	---	---	---
II (N)	162,550	120,680	3,850	---	38,020
(I)	124,530	120,680	3,850	---	---
III (N)	61,620	43,440	18,180	---	---
(I)	60,500	44,400	16,100	---	---
IV (N)	30,960	27,320	3,640	---	---
(I)	102,340	93,810	7,000	1,530	---
V (N)	4,250	---	4,250	---	---
VI (N)	231,175	216,060	5,070	10,045	---
VII (N)	173,149	148,104	---	25,045	---
VIII (N)	1,330	---	990	340	---

TABLE 8.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES

(Only the soils that support rangeland vegetation suitable for grazing are listed)

Soil name and map symbol	Range site	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Composition
			Lb/acre		Pct
Ad: Alda	Subirrigated	Favorable	4,700	Big bluestem	25
		Normal	4,400	Little bluestem	20
		Unfavorable	4,100	Prairie cordgrass	15
				Switchgrass	10
				Indiangrass	10
AwF*:					
Altvan	Silty	Favorable	2,900	Little bluestem	15
		Normal	2,500	Blue grama	15
		Unfavorable	2,100	Western wheatgrass	15
				Needleandthread	15
				Big bluestem	10
				Sideoats grama	5
				Buffalograss	5
				Threadleaf sedge	5
Dix	Shallow to Gravel	Favorable	1,000	Blue grama	20
		Normal	800	Sand bluestem	10
		Unfavorable	600	Little bluestem	10
				Prairie sandreed	10
				Sand dropseed	10
				Fendler threeawn	5
				Needleandthread	5
				Buffalograss	5
Bb: Bankard	Shallow to Gravel	Favorable	1,400	Blue grama	20
		Normal	1,200	Prairie sandreed	15
		Unfavorable	700	Little bluestem	10
				Sand bluestem	10
				Needleandthread	10
				Sand dropseed	5
				Clubmoss	5
				Hairy grama	5
Bc: Bankard	Sandy Lowland	Favorable	3,000	Sand bluestem	30
		Normal	2,400	Prairie sandreed	25
		Unfavorable	1,750	Little bluestem	20
				Switchgrass	10
				Blue grama	5
				Sand lovegrass	5
				Sand dropseed	5
Bd: Bankard	Shallow to Gravel	Favorable	1,250	Blue grama	30
		Normal	900	Sand bluestem	15
		Unfavorable	600	Prairie sandreed	10
				Sand dropseed	10
				Needleandthread	10
				Little bluestem	10
				Sand sagebrush	5
				Sedge	5
				Clubmoss	5
BeB: Bayard	Sandy	Favorable	3,000	Prairie sandreed	25
		Normal	2,300	Sand bluestem	20
		Unfavorable	1,700	Little bluestem	20
				Blue grama	10
				Needleandthread	10
				Threadleaf sedge	5

See footnote at end of table.

TABLE 8.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Composition
			Lb/acre		Pct
Bo: Boel	Subirrigated	Favorable	5,200	Big bluestem	30
		Normal	4,900	Indiangrass	15
		Unfavorable	4,600	Little bluestem	10
				Switchgrass	10
				Prairie cordgrass	10
				Sedge	5
Bs, BtB: Bridget	Silty	Favorable	3,300	Needleandthread	20
		Normal	2,500	Blue grama	15
		Unfavorable	1,700	Western wheatgrass	15
				Threadleaf sedge	10
				Little bluestem	10
				Big bluestem	10
				Buffalograss	5
				Sideoats grama	5
ChB: Chappell	Sandy	Favorable	2,600	Prairie sandreed	25
		Normal	2,300	Sand bluestem	25
		Unfavorable	1,900	Little bluestem	15
				Needleandthread	10
				Blue grama	10
				Threadleaf sedge	5
Cu: Cullison	Wet Subirrigated	Favorable	5,400	Big bluestem	20
		Normal	5,100	Switchgrass	15
		Unfavorable	4,800	Prairie cordgrass	15
				Indiangrass	10
				Slender wheatgrass	5
				Plains bluegrass	5
Cz: Cullison	Wetland	Favorable	5,600	Prairie cordgrass	30
		Normal	5,400	Northern reedgrass	15
		Unfavorable	5,300	Bluejoint reedgrass	15
				Slender wheatgrass	10
				Rush	5
DfE: Dix	Shallow to Gravel	Favorable	1,000	Blue grama	20
		Normal	800	Sand bluestem	10
		Unfavorable	600	Little bluestem	10
				Prairie sandreed	10
				Sand dropseed	10
				Fendler threeawn	5
				Needleandthread	5
				Buffalograss	5
DsG*:					
Dix	Shallow to Gravel	Favorable	1,000	Blue grama	20
		Normal	800	Sand bluestem	10
		Unfavorable	600	Little bluestem	10
				Prairie sandreed	10
				Sand dropseed	10
				Fendler threeawn	5
				Needleandthread	5
				Buffalograss	5

See footnote at end of table.

TABLE 8.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Composition
			Lb/acre		Pct
DsG*:					
Sully	Thin Loess	Favorable	2,300	Little bluestem	25
		Normal	1,700	Sideoats grama	15
		Unfavorable	1,000	Blue grama	10
				Big bluestem	10
				Plains muhly	10
				Western wheatgrass	5
				Threadleaf sedge	5
Sarben	Sandy	Favorable	3,000	Prairie sandreed	20
		Normal	2,600	Needleandthread	20
		Unfavorable	2,200	Little bluestem	15
				Blue grama	10
				Sand bluestem	10
				Sand sagebrush	5
				Western wheatgrass	5
				Sedge	5
Dt, DtB, Du, DuB: Duroc	Silty	Favorable	3,300	Big bluestem	15
		Normal	2,500	Needleandthread	15
		Unfavorable	1,700	Western wheatgrass	15
				Blue grama	10
				Green needlegrass	10
				Little bluestem	10
				Threadleaf sedge	10
				Buffalograss	5
IpB: Ipage	Sandy Lowland	Favorable	3,500	Sand bluestem	25
		Normal	3,200	Little bluestem	20
		Unfavorable	3,000	Prairie sandreed	15
				Needleandthread	10
				Indiangrass	5
				Sedge	5
				Switchgrass	5
				Blue grama	5
Ja: Janise	Saline Subirrigated	Favorable	2,900	Alkali sacaton	35
		Normal	2,600	Inland saltgrass	15
		Unfavorable	2,300	Western wheatgrass	15
				Slender wheatgrass	10
				Plains bluegrass	10
				Sedge	5
Jd: Janise	Saline Lowland	Favorable	2,300	Alkali sacaton	35
		Normal	2,000	Inland saltgrass	15
		Unfavorable	1,800	Western wheatgrass	10
				Blue grama	10
				Slender wheatgrass	5
				Sand dropseed	5
				Sedge	5
				Buffalograss	5
KeB, KeC: Keith	Silty	Favorable	3,300	Blue grama	20
		Normal	2,500	Needleandthread	20
		Unfavorable	1,700	Western wheatgrass	15
				Buffalograss	10
				Little bluestem	10
				Sedge	5
				Big bluestem	5
				Sideoats grama	5

See footnote at end of table.

TABLE 8.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Composition
			Lb/acre		Pct
Ku, KuB: Kuma	Silty	Favorable	2,500	Blue grama	60
		Normal	1,500	Buffalograss	10
		Unfavorable	1,000	Western wheatgrass	10
				Needlegrass	5
La: Lawet	Wet Subirrigated	Favorable	5,600	Switchgrass	20
		Normal	5,400	Big bluestem	15
		Unfavorable	5,300	Northern reedgrass	10
				Indiangrass	10
				Prairie cordgrass	10
				Bluejoint reedgrass	5
				Slender wheatgrass	5
				Plains bluegrass	5
Le: Lex	Subirrigated	Favorable	4,700	Big bluestem	35
		Normal	4,400	Little bluestem	10
		Unfavorable	4,100	Switchgrass	10
				Indiangrass	10
				Prairie cordgrass	10
				Slender wheatgrass	5
Lp: Lodgepole	Clayey Overflow	Favorable	1,200	Western wheatgrass	40
		Normal	1,000	Blue grama	15
		Unfavorable	700	Buffalograss	15
				Green needlegrass	10
				Sedge	10
Me: Merrick	Silty Lowland	Favorable	3,800	Big bluestem	20
		Normal	3,000	Western wheatgrass	20
		Unfavorable	2,300	Needleandthread	20
				Little bluestem	15
				Blue grama	10
				Switchgrass	5
No: Norwest	Subirrigated	Favorable	5,500	Big bluestem	25
		Normal	5,300	Little bluestem	15
		Unfavorable	5,000	Indiangrass	15
				Switchgrass	10
				Prairie cordgrass	10
				Sedge	10
Pt: Platte	Subirrigated	Favorable	4,500	Big bluestem	30
		Normal	4,100	Little bluestem	20
		Unfavorable	3,700	Switchgrass	10
				Indiangrass	10
				Prairie cordgrass	10
RtB, RtD: Rosebud	Silty	Favorable	3,300	Needleandthread	15
		Normal	2,500	Blue grama	15
		Unfavorable	1,700	Western wheatgrass	15
				Little bluestem	10
				Sideoats grama	10
				Green needlegrass	10
				Big bluestem	5
				Threadleaf sedge	5
				Buffalograss	5

See footnote at end of table.

TABLE 8.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Composition
			Lb/acre		Pct
SaB, SaC, SaD, SaE--Sarben	Sandy	Favorable	3,000	Prairie sandreed	20
		Normal	2,600	Needleandthread	20
		Unfavorable	2,200	Little bluestem	15
				Blue grama	10
				Sand bluestem	10
				Sand sagebrush	5
				Western wheatgrass	5
				Sedge	5
Sb, SbB, SbC--Satanta	Silty	Favorable	3,200	Blue grama	20
		Normal	2,500	Western wheatgrass	20
		Unfavorable	1,800	Big bluestem	15
				Little bluestem	15
				Needleandthread	15
				Sideoats grama	10
ScD*:					
Satanta	Silty	Favorable	3,200	Blue grama	20
		Normal	2,500	Western wheatgrass	20
		Unfavorable	1,800	Big bluestem	15
				Little bluestem	15
				Needleandthread	15
				Sideoats grama	10
Dix	Shallow to Gravel	Favorable	1,000	Blue grama	20
		Normal	800	Sand bluestem	10
		Unfavorable	600	Little bluestem	10
				Prairie sandreed	10
				Sand dropseed	10
				Fendler threeawn	5
				Needleandthread	5
				Buffalograss	5
SfD--Sully	Limy Upland	Favorable	2,800	Little bluestem	25
		Normal	2,000	Sideoats grama	15
		Unfavorable	1,500	Blue grama	15
				Big bluestem	10
				Threadleaf sedge	10
				Western wheatgrass	5
				Buffalograss	5
				Plains muhly	5
SfG--Sully	Thin Loess	Favorable	2,300	Little bluestem	25
		Normal	1,700	Sideoats grama	15
		Unfavorable	1,000	Blue grama	10
				Big bluestem	10
				Plains muhly	10
				Western wheatgrass	5
				Threadleaf sedge	5
SkE*:					
Sully	Limy Upland	Favorable	2,800	Little bluestem	25
		Normal	2,000	Sideoats grama	15
		Unfavorable	1,500	Blue grama	15
				Big bluestem	10
				Threadleaf sedge	10
				Western wheatgrass	5
				Buffalograss	5
				Plains muhly	5

See footnote at end of table.

TABLE 8.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Composition
			Lb/acre		Pct
SkE*:					
Dix	Shallow to Gravel	Favorable	1,000	Blue grama	20
		Normal	800	Sand bluestem	10
		Unfavorable	600	Little bluestem	10
				Prairie sandreed	10
				Sand dropseed	10
				Fendler threeawn	5
				Needleandthread	5
				Buffalograss	5
SmE2*, SmF*:					
Sully	Limy Upland	Favorable	2,800	Little bluestem	25
		Normal	2,000	Sideoats grama	15
		Unfavorable	1,500	Blue grama	15
				Big bluestem	10
				Threadleaf sedge	10
				Western wheatgrass	5
				Buffalograss	5
				Plains muhly	5
McConaughy	Silty	Favorable	3,250	Western wheatgrass	15
		Normal	2,500	Blue grama	15
		Unfavorable	1,700	Needleandthread	15
				Little bluestem	10
				Big bluestem	10
				Sideoats grama	5
				Sedge	5
TaG*:					
Tassel	Shallow Limy	Favorable	1,500	Little bluestem	20
		Normal	1,100	Blue grama	20
		Unfavorable	700	Needleandthread	15
				Sand bluestem	10
				Western wheatgrass	10
				Sideoats grama	10
				Threadleaf sedge	5
Otero	Limy Upland	Favorable	2,400	Little bluestem	20
		Normal	2,000	Prairie sandreed	15
		Unfavorable	1,700	Sand bluestem	15
				Blue grama	10
				Needleandthread	10
				Threadleaf sedge	10
				Sideoats grama	5
Rock outcrop.					
VdB Valent	Sandy	Favorable	2,600	Prairie sandreed	20
		Normal	2,300	Sand bluestem	15
		Unfavorable	1,900	Little bluestem	15
				Needleandthread	15
				Blue grama	10
				Sand dropseed	5
				Threadleaf sedge	5
VdD, VdE Valent	Sands	Favorable	3,000	Sand bluestem	25
		Normal	2,600	Prairie sandreed	20
		Unfavorable	2,000	Little bluestem	10
				Needleandthread	10
				Switchgrass	10
				Blue grama	5

See footnote at end of table.

TABLE 8.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Composition
			Lb/acre		Pct
VdF*:					
Valent	Sands	Favorable	3,000	Sand bluestem	25
		Normal	2,600	Prairie sandreed	20
		Unfavorable	2,000	Little bluestem	10
				Needleandthread	10
				Switchgrass	10
				Blue grama	5
Valent	Choppy Sands	Favorable	2,800	Sand bluestem	30
		Normal	2,400	Prairie sandreed	20
		Unfavorable	1,800	Little bluestem	15
				Switchgrass	10
				Blue grama	5
				Needleandthread	5
VgG Valent	Choppy Sands	Favorable	2,800	Sand bluestem	30
		Normal	2,400	Prairie sandreed	20
		Unfavorable	1,800	Little bluestem	15
				Switchgrass	10
				Blue grama	5
				Needleandthread	5
VtG*:					
Valent	Sands	Favorable	3,000	Sand bluestem	25
		Normal	2,600	Prairie sandreed	20
		Unfavorable	2,000	Little bluestem	10
				Needleandthread	10
				Switchgrass	10
				Blue grama	5
Tassel	Shallow Limy	Favorable	1,500	Little bluestem	20
		Normal	1,100	Blue grama	20
		Unfavorable	700	Needleandthread	15
				Sand bluestem	10
				Western wheatgrass	10
				Sideoats grama	10
				Threadleaf sedge	5
Rock outcrop.					
VwB Vetal	Sandy	Favorable	2,000	Needleandthread	25
		Normal	1,500	Blue grama	25
		Unfavorable	800	Threadleaf sedge	15
				Prairie sandreed	10
				Western wheatgrass	10
				Sand dropseed	5
Wa Wann	Subirrigated	Favorable	5,000	Big bluestem	25
		Normal	4,800	Little bluestem	20
		Unfavorable	4,500	Prairie cordgrass	15
				Indiangrass	10
				Switchgrass	5
				Sedge	5
				Slender wheatgrass	5
				Plains bluegrass	5

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 9.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS

(The symbol < means less than; > means more than. Absence of an entry indicates that trees generally do not grow to the given height on that soil)

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
Ad: Alda	American plum, redosier dogwood.	Common chokecherry	Eastern redcedar, Austrian pine, Russian mulberry, hackberry, green ash.	Honeylocust, silver maple, golden willow.	Eastern cottonwood.
AwF*: Altvan	Skunkbush sumac, lilac, Siberian peashrub, Peking cotoneaster.	Eastern redcedar, Rocky Mountain juniper, Russian-olive, hackberry, green ash.	Ponderosa pine, Siberian elm, honeylocust.	---	---
Dix.					
Bb, Bc, Bd. Bankard					
BeB: Bayard	American plum, skunkbush sumac, Siberian peashrub.	Eastern redcedar, Rocky Mountain juniper, lilac.	Ponderosa pine, Russian mulberry, green ash, hackberry, honeylocust.	Siberian elm	---
Bo: Boel	Redosier dogwood, American plum.	Common chokecherry	Hackberry, green ash, Austrian pine, Russian mulberry, eastern redcedar.	Honeylocust, silver maple, golden willow.	Eastern cottonwood.
Bs, BtB: Bridget	Amur honeysuckle, lilac.	Rocky Mountain juniper, Russian-olive, common chokecherry, American plum.	Hackberry, ponderosa pine, green ash, eastern redcedar, honeylocust.	Siberian elm	---
ChB: Chappell	Skunkbush sumac, lilac, Siberian peashrub, Peking cotoneaster.	Eastern redcedar, Rocky Mountain juniper, Russian-olive, hackberry, green ash.	Ponderosa pine, Siberian elm, honeylocust.	---	---
Cu: Cullison	Redosier dogwood	---	---	Golden willow	Eastern cottonwood.
Cz. Cullison					
DfE. Dix					
DsG*: Dix.					

See footnote at end of table.

TABLE 9.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
DsG*: Sully.					
Sarben.					
Dt----------------Duroc	Amur honeysuckle, lilac, American plum.	---	Rocky Mountain juniper, ponderosa pine, honeylocust, green ash, Russian-olive, eastern redcedar, hackberry.	Siberian elm------	Eastern cottonwood.
DtB---------------Duroc	Lilac, American plum.	Rocky Mountain juniper, Siberian peashrub, skunkbush sumac, hackberry.	Ponderosa pine, honeylocust, eastern redcedar, Scotch pine, green ash.	Siberian elm------	---
Du----------------Duroc	Amur honeysuckle, lilac, American plum.	---	Rocky Mountain juniper, ponderosa pine, honeylocust, green ash, Russian-olive, eastern redcedar, hackberry.	Siberian elm------	Eastern cottonwood.
DuB---------------Duroc	Lilac, American plum.	Rocky Mountain juniper, Siberian peashrub, skunkbush sumac, hackberry.	Ponderosa pine, honeylocust, eastern redcedar, Scotch pine, green ash.	Siberian elm------	---
Fu*. Fluvaquents					
Go. Gothenburg					
IpB---------------Ipage	---	Eastern redcedar, Rocky Mountain juniper.	Ponderosa pine, Austrian pine, jack pine.	---	---
Ja, Jd. Janise					
KeB, KeC----------Keith	Lilac, American plum.	Rocky Mountain juniper, Manchurian crabapple, common chokecherry, Siberian peashrub.	Hackberry, ponderosa pine, green ash, honeylocust, Russian-olive.	Siberian elm------	---
Ku, KuB-----------Kuma	Fragrant sumac, lilac, Amur honeysuckle.	Russian-olive, common chokecherry.	Eastern redcedar, green ash, ponderosa pine, honeylocust, bur oak.	Siberian elm------	---

See footnote at end of table.

TABLE 9.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of-- <8	8-15	16-25	26-35	>35
La----------------Lawet	Lilac-------------	Common chokecherry, Siberian peashrub.	Eastern redcedar, ponderosa pine, green ash, hackberry.	Golden willow, honeylocust, silver maple.	Eastern cottonwood.
Le----------------Lex	Common chokecherry, lilac, American plum, Siberian peashrub.	---	Eastern redcedar, hackberry, ponderosa pine, green ash, Russian mulberry, honeylocust.	Golden willow-----	Eastern cottonwood.
Lp----------------Lodgepole	American plum, common chokecherry, lilac.	---	Eastern redcedar, ponderosa pine, honeylocust, hackberry, green ash, Russian mulberry.	Silver maple, golden willow.	Eastern redcedar.
Ma. Marlake					
Me----------------Merrick	Peking cotoneaster	American plum, lilac, Siberian peashrub.	Eastern redcedar, ponderosa pine, Manchurian crabapple.	Green ash, honeylocust, hackberry, golden willow.	Eastern cottonwood.
No----------------Norwest	Lilac, American plum.	Amur honeysuckle, Rocky Mountain juniper.	Eastern redcedar, hackberry, ponderosa pine, green ash, honeylocust.	Siberian elm, golden willow.	Eastern cottonwood.
Pp*. Pits and dumps					
Pt----------------Platte	Redosier dogwood, American plum.	Common chokecherry	Hackberry, green ash, Austrian pine, Russian-olive, eastern redcedar.	Honeylocust, silver maple, golden willow.	Eastern cottonwood.
RtB, RtD----------Rosebud	Skunkbush sumac, Siberian peashrub, lilac, Peking cotoneaster.	Eastern redcedar, Rocky Mountain juniper, Russian-olive, hackberry, green ash.	Ponderosa pine, Siberian elm, honeylocust.	---	---
SaB, SaC----------Sarben	Amur honeysuckle, American plum, common chokecherry, lilac.	Russian mulberry, Rocky Mountain juniper.	Eastern redcedar, ponderosa pine, hackberry, green ash, honeylocust.	Siberian elm------	---
SaD, SaE----------Sarben	---	Eastern redcedar, Rocky Mountain juniper.	Ponderosa pine----	---	---

See footnote at end of table.

TABLE 9.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of-- <8	8-15	16-25	26-35	>35
Sb, SbB, SbC: Satanta	---	Autumn olive, Rocky Mountain juniper, common chokecherry, American plum, Tatarian honeysuckle.	Eastern redcedar, green ash, black locust, hackberry, ponderosa pine, honeylocust.	Siberian elm	---
ScD*: Satanta	---	Autumn olive, Rocky Mountain juniper, common chokecherry, American plum, Tatarian honeysuckle.	Eastern redcedar, green ash, black locust, hackberry, ponderosa pine, honeylocust.	Siberian elm	---
Dix.					
SfD: Sully	Silver buffaloberry, lilac.	Eastern redcedar, Tatarian honeysuckle, Rocky Mountain juniper, Siberian peashrub.	Siberian elm, hackberry, green ash, honeylocust, ponderosa pine, black locust.	---	---
SfG. Sully					
SkE*: Sully	Silver buffaloberry, lilac.	Eastern redcedar, Tatarian honeysuckle, Rocky Mountain juniper, Siberian peashrub.	Siberian elm, hackberry, green ash, honeylocust, ponderosa pine, black locust.	---	---
Dix.					
SmE2*: Sully	Silver buffaloberry, lilac.	Eastern redcedar, Tatarian honeysuckle, Rocky Mountain juniper, Siberian peashrub.	Siberian elm, hackberry, green ash, honeylocust, ponderosa pine, black locust.	---	---
McConaughy	American plum, lilac, skunkbush sumac.	Russian-olive, hackberry, Siberian peashrub, Rocky Mountain juniper.	Eastern redcedar, green ash, honeylocust, ponderosa pine.	Siberian elm	---
SmF*: Sully.					
McConaughy	American plum, lilac, skunkbush sumac.	Russian-olive, hackberry, Siberian peashrub, Rocky Mountain juniper.	Eastern redcedar, green ash, honeylocust, ponderosa pine.	Siberian elm	---

See footnote at end of table.

TABLE 9.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of-- <8	8-15	16-25	26-35	>35
TaG*:					
Tassel.					
Otero	Siberian peashrub, silver buffaloberry, skunkbush sumac, Tatarian honeysuckle.	Eastern redcedar, Rocky Mountain juniper, ponderosa pine, green ash, Russian-olive, black locust.	Honeylocust, Siberian elm.	---	---
Rock outcrop.					
VdB, VdD, VdE. Valent					
VdF*:					
Valent.					
Valent.					
VgG. Valent					
VtG*:					
Valent.					
Tassel.					
Rock outcrop.					
VwB Vetal	Skunkbush sumac, common chokecherry, American plum, lilac.	Siberian peashrub	Honeylocust, Austrian pine, green ash, ponderosa pine, Rocky Mountain juniper, eastern redcedar.	Siberian elm	---
Wa Wann	Lilac	Common chokecherry, Siberian peashrub, American plum.	Ponderosa pine, green ash, hackberry, eastern redcedar.	Golden willow, silver maple.	Eastern cottonwood.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 10.--RECREATIONAL DEVELOPMENT

(Some terms that describe restrictive soil features are defined in the "Glossary." See text for definitions of "slight," "moderate," and "severe")

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
Ad: Alda	Severe: flooding.	Moderate: wetness.	Moderate: small stones, wetness.	Slight.
AwF*: Altvan	Moderate: slope, dusty.	Moderate: slope, dusty.	Severe: slope.	Moderate: dusty.
Dix	Severe: slope.	Severe: slope.	Severe: slope, small stones.	Moderate: slope, dusty.
Bb: Bankard	Severe: flooding, too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.
Bc: Bankard	Severe: flooding.	Slight	Slight	Slight.
Bd: Bankard	Severe: flooding.	Moderate: flooding.	Severe: flooding.	Moderate: flooding.
BeB: Bayard	Moderate: dusty.	Moderate: dusty.	Moderate: slope.	Moderate: dusty.
Bo: Boel	Severe: flooding.	Moderate: wetness.	Moderate: wetness.	Moderate: wetness.
Bs: Bridget	Moderate: dusty.	Moderate: dusty.	Moderate: dusty.	Moderate: dusty.
BtB: Bridget	Moderate: dusty.	Moderate: dusty.	Moderate: slope, dusty.	Moderate: dusty.
ChB: Chappell	Slight	Slight	Slight	Slight.
Cu: Cullison	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
Cz: Cullison	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
DfE: Dix	Severe: slope.	Severe: slope.	Severe: slope, small stones.	Moderate: slope, dusty.
DsG*: Dix	Severe: slope.	Severe: slope.	Severe: slope, small stones.	Severe: slope.

See footnote at end of table.

TABLE 10.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
DsG*:				
Sully	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope, erodes easily.
Sarben	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Dt Duroc	Slight	Slight	Slight	Slight.
DtB Duroc	Slight	Slight	Moderate: slope.	Slight.
Du Duroc	Slight	Slight	Slight	Slight.
DuB Duroc	Slight	Slight	Moderate: slope.	Slight.
Fu* Fluvaquents	Severe: flooding, ponding.	Severe: ponding.	Severe: ponding, flooding.	Severe: ponding.
Go Gothenburg	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
IpB Ipage	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.
Ja, Jd Janise	Severe: flooding, excess sodium.	Severe: excess sodium.	Severe: excess sodium.	Slight.
KeB, KeC Keith	Moderate: dusty.	Moderate: dusty.	Moderate: slope, dusty.	Moderate: dusty.
Ku Kuma	Slight	Slight	Slight	Slight.
KuB Kuma	Slight	Slight	Moderate: slope.	Slight.
La Lawet	Severe: flooding, wetness.	Moderate: wetness, percs slowly.	Severe: wetness.	Moderate: wetness.
Le Lex	Severe: flooding.	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Moderate: wetness.
Lp Lodgepole	Severe: ponding, percs slowly.	Severe: ponding, percs slowly.	Severe: ponding, percs slowly.	Severe: ponding.
Ma Marlake	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.

See footnote at end of table.

TABLE 10.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
Me------------------- Merrick	Severe: flooding.	Slight	Slight	Slight.
No------------------- Norwest	Severe: flooding.	Moderate: wetness.	Moderate: wetness.	Moderate: wetness.
Pp*------------------ Pits and dumps	Severe: flooding, slope, small stones.	Severe: slope, too sandy, small stones.	Severe: slope, small stones, too sandy.	Severe: too sandy.
Pt------------------- Platte	Severe: flooding, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.
RtB------------------ Rosebud	Moderate: dusty.	Moderate: dusty.	Moderate: slope, depth to rock.	Moderate: dusty.
RtD------------------ Rosebud	Moderate: dusty.	Moderate: dusty.	Severe: slope.	Moderate: dusty.
SaB------------------ Sarben	Slight	Slight	Slight	Slight.
SaC------------------ Sarben	Slight	Slight	Moderate: slope.	Slight.
SaD------------------ Sarben	Slight	Slight	Severe: slope.	Slight.
SaE------------------ Sarben	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
Sb------------------- Satanta	Moderate: dusty.	Moderate: dusty.	Moderate: dusty.	Moderate: dusty.
SbB, SbC------------- Satanta	Moderate: dusty.	Moderate: dusty.	Moderate: slope, dusty.	Moderate: dusty.
ScD*:				
Satanta--------------	Moderate: dusty.	Moderate: dusty.	Severe: slope.	Moderate: dusty.
Dix------------------	Moderate: small stones, dusty.	Moderate: small stones, dusty.	Severe: slope, small stones.	Moderate: dusty.
SfD------------------ Sully	Slight	Slight	Severe: slope.	Severe: erodes easily.
SfG------------------ Sully	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope, erodes easily.
SkE*:				
Sully----------------	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: erodes easily.

See footnote at end of table.

TABLE 10.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
SkE*:				
Dix	Moderate: slope, small stones, dusty.	Moderate: slope, small stones, dusty.	Severe: slope, small stones.	Moderate: dusty.
SmE2*:				
Sully	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: erodes easily.
McConaughy	Moderate: slope, dusty.	Moderate: slope, dusty.	Severe: slope.	Moderate: dusty.
SmF*:				
Sully	Severe: slope.	Severe: slope.	Severe: slope.	Severe: erodes easily.
McConaughy	Moderate: slope, dusty.	Moderate: slope, dusty.	Severe: slope.	Moderate: dusty.
TaG*:				
Tassel	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, erodes easily.
Otero	Severe: slope.	Severe: slope.	Severe: slope.	Severe: erodes easily.
Rock outcrop	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope.
VdB Valent	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.
VdD Valent	Severe: too sandy.	Severe: too sandy.	Severe: slope, too sandy.	Severe: too sandy.
VdE Valent	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: too sandy.
VdF*:				
Valent	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: too sandy.
Valent	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: too sandy, slope.
VgG Valent	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: too sandy, slope.

See footnote at end of table.

TABLE 10.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
VtG*:				
Valent	Severe: too sandy.	Severe: too sandy.	Severe: slope, too sandy.	Severe: too sandy.
Tassel	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope.
Rock outcrop	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope.
VwB: Vetal	Slight	Slight	Slight	Slight.
Wa: Wann	Severe: flooding.	Moderate: wetness.	Moderate: wetness.	Moderate: wetness.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 11.--WILDLIFE HABITAT

(See text for definitions of "good," "fair," "poor," and "very poor." Absence of an entry indicates that the soil was not rated)

Soil name and map symbol	Potential for habitat elements: Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Shrubs	Wetland plants	Shallow water areas	Potential as habitat for--: Openland wildlife	Woodland wildlife	Wetland wildlife	Rangeland wildlife
Ad------------------ Alda	Fair	Fair	Fair	Good	Good	Good	Fair	Fair	Fair	Good	Fair	Good.
AwF*:												
Altvan------------	Poor	Fair	Good	Good	Fair	Good	Very poor.	Very poor.	Fair	Good	Very poor.	Good.
Dix---------------	Poor	Poor	Poor	Poor	Poor	Poor	Very poor.	Very poor.	Very poor.	Poor	Very poor.	Poor.
Bb, Bc, Bd--------- Bankard	Poor	Fair	Fair	---	---	Fair	Poor	Very poor.	Fair	---	Very poor.	Fair.
BeB---------------- Bayard	Good	Good	Good	Good	Good	Fair	Poor	Very poor.	Good	Good	Very poor.	Fair.
Bo----------------- Boel	Fair	Fair	Good	Good	Good	Good	Fair	Fair	Fair	Good	Poor	Fair.
Bs, BtB------------ Bridget	Good	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.	Good.
ChB---------------- Chappell	Fair	Good	Good	---	Good	Good	Very poor.	Very poor.	Fair	---	Very poor.	Good.
Cu----------------- Cullison	Very poor.	Poor	Fair	Poor	Poor	Fair	Good	Good	Poor	Poor	Good	Fair.
Cz----------------- Cullison	Very poor.	Poor	Fair	Poor	Fair	Fair	Good	Good	Poor	Poor	Good	Fair.
DfE---------------- Dix	Poor	Poor	Poor	Poor	Poor	Poor	Very poor.	Very poor.	Very poor.	Poor	Very poor.	Poor.
DsG*:												
Dix---------------	Very poor.	Very poor.	Very poor.	Very poor.	Poor	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.
Sully-------------	Very poor.	Very poor.	Fair	Poor	Poor	Fair	Very poor.	Very poor.	Poor	Poor	Very poor.	Fair.
Sarben------------	Poor	Fair	Fair	Fair	Poor	Poor	Very poor.	Very poor.	Poor	Fair	Very poor.	Fair.
Dt, DtB, Du, DuB--- Duroc	Good	Good	Fair	Good	Good	Fair	Poor	Very poor.	Good	Good	Very poor.	Fair.
Fu*---------------- Fluvaquents	Very poor.	Very poor.	Poor	Very poor.	Very poor.	Very poor.	Good	Good	Very poor.	Very poor.	Good	Very poor.
Go----------------- Gothenburg	Very poor.	Very poor.	Fair	Poor	Fair	Fair	Fair	Good	Poor	Poor	Fair	Fair.
IpB---------------- Ipage	Poor	Good	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair.

See footnote at end of table.

TABLE 11.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements: Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Shrubs	Wetland plants	Shallow water areas	Potential as habitat for--: Openland wildlife	Woodland wildlife	Wetland wildlife	Rangeland wildlife
Ja----------------- Janise	Poor	Poor	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Fair	Poor	Very poor.	Poor	Very poor.
Jd----------------- Janise	Poor	Poor	Very poor.	Poor	Poor	Poor	Poor	Poor	Poor	Poor	Poor	Poor.
KeB---------------- Keith	Good	Good	Good	Fair	Fair	Good	Very poor.	Very poor.	Good	Fair	Very poor.	Good.
KeC---------------- Keith	Fair	Good	Good	Fair	Fair	Good	Very poor.	Very poor.	Good	Fair	Very poor.	Good.
Ku, KuB------------ Kuma	Good	Good	Fair	---	---	Poor	Poor	Very poor.	Fair	---	Very poor.	Poor.
La----------------- Lawet	Poor	Fair	Fair	Fair	Fair	Fair	Good	Good	Fair	Fair	Good	Poor.
Le----------------- Lex	Fair	Fair	Good	Fair	Good	Good	Fair	Fair	Fair	Fair	Fair	Good.
Lp----------------- Lodgepole	Poor	Fair	Fair	Poor	Poor	Poor	Good	Good	Fair	Poor	Good	Poor.
Ma----------------- Marlake	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Good	Good	Very poor.	Very poor.	Good	Very poor.
Me----------------- Merrick	Good	Good	Good	Good	Good	Good	Poor	Poor	Poor	Good	Poor	Good.
No----------------- Norwest	Good	Good	Good	Good	Fair	Good	Fair	Good	Good	Good	Fair	Good.
Pp*---------------- Pits and dumps	Very poor.	Very poor.	Poor	Poor	Poor	Poor	Very poor.	Fair	Very poor.	Very poor.	Poor	Poor.
Pt----------------- Platte	Fair	Good	Fair	Poor	Fair	Good	Fair	Good	Fair	Poor	Good	Fair.
RtB---------------- Rosebud	Good	Good	Fair	---	Good	Fair	Very poor.	Very poor.	Fair	---	Very poor.	Fair.
RtD---------------- Rosebud	Fair	Good	Fair	---	Good	Fair	Very poor.	Very poor.	Fair	---	Very poor.	Fair.
SaB, SaC, SaD------ Sarben	Fair	Good	Good	Fair	Fair	Good	Very poor.	Very poor.	Good	Fair	Very poor.	Good.
SaE---------------- Sarben	Poor	Fair	Fair	Fair	Poor	Poor	Very poor.	Very poor.	Poor	Fair	Very poor.	Fair.
Sb, SbB------------ Satanta	Good	Good	Fair	Good	Good	Fair	Poor	Very poor.	Good	Good	Very poor.	Fair.
SbC---------------- Satanta	Fair	Good	Fair	Good	Good	Fair	Poor	Very poor.	Fair	Good	Very poor.	Fair.
ScD*:												
Satanta-----------	Fair	Good	Fair	Good	Good	Fair	Poor	Very poor.	Fair	Good	Very poor.	Fair.

See footnote at end of table.

TABLE 11.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements: Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Shrubs	Wetland plants	Shallow water areas	Potential as habitat for--: Openland wildlife	Woodland wildlife	Wetland wildlife	Rangeland wildlife
ScD*:												
Dix	Poor	Poor	Poor	Poor	Poor	Poor	Very poor.	Very poor.	Very poor.	Poor	Very poor.	Poor.
SfD Sully	Fair	Good	Fair	Good	Good	Fair	Poor	Very poor.	Fair	Good	Very poor.	Fair.
SfG Sully	Very poor.	Very poor.	Fair	Poor	Poor	Fair	Very poor.	Very poor.	Poor	Poor	Very poor.	Fair.
SkE*:												
Sully	Poor	Fair	Fair	Good	Good	Fair	Very poor.	Very poor.	Fair	Good	Very poor.	Fair.
Dix	Poor	Poor	Poor	Poor	Poor	Poor	Very poor.	Very poor.	Very poor.	Poor	Very poor.	Poor.
SmE2*, SmF*:												
Sully	Poor	Fair	Fair	Good	Good	Fair	Very poor.	Very poor.	Fair	Good	Very poor.	Fair.
McConaughy	Poor	Fair	Fair	Good	Good	Fair	Very poor.	Very poor.	Fair	Good	Very poor.	Fair.
TaG*:												
Tassel	Very poor.	Very poor.	Poor	Fair	Fair	Poor	Very poor.	Very poor.	Very poor.	Fair	Very poor.	Poor.
Otero	Poor	Fair	Good	Good	Good	Fair	Poor	Very poor.	Fair	Good	Very poor.	Fair.
Rock outcrop	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.
VdB, VdD, VdE Valent	Poor	Fair	Fair	Poor	Poor	Poor	Very poor.	Very poor.	Fair	Poor	Very poor.	Fair.
VdF*:												
Valent	Poor	Fair	Fair	Poor	Poor	Poor	Very poor.	Very poor.	Fair	Poor	Very poor.	Fair.
Valent	Very poor.	Very poor.	Fair	Poor	Poor	Poor	Very poor.	Very poor.	Poor	Poor	Very poor.	Fair.
VgG Valent	Very poor.	Very poor.	Fair	Poor	Poor	Poor	Very poor.	Very poor.	Poor	Poor	Very poor.	Fair.
VtG*:												
Valent	Poor	Fair	Fair	Poor	Poor	Poor	Very poor.	Very poor.	Fair	Poor	Very poor.	Fair.
Tassel	Very poor.	Very poor.	Poor	Fair	Fair	Poor	Very poor.	Very poor.	Very poor.	Fair	Very poor.	Poor.
Rock outcrop	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.
VwB Vetal	Fair	Fair	Fair	Fair	Fair	Fair	Poor	Very poor.	Fair	Fair	Very poor.	Fair.

See footnote at end of table.

TABLE 11.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements								Potential as habitat for--			
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife	Rangeland wildlife
Wa----------------- Wann	Good	Good	Good	Good	Fair	Good	Poor	Fair	Good	Good	Fair	Good.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 12.--BUILDING SITE DEVELOPMENT

(Some terms that describe restrictive soil features are defined in the "Glossary." See text for definitions of "slight," "moderate," and "severe." The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
Ad: Alda	Severe: cutbanks cave, wetness.	Severe: flooding.	Severe: flooding, wetness.	Severe: flooding.	Severe: flooding, frost action.	Moderate: flooding.
AwF*:						
Altvan	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope, frost action.	Moderate: slope.
Dix	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: droughty, slope.
Bb: Bankard	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: flooding.	Moderate: droughty, too sandy.
Bc: Bankard	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: flooding.	Moderate: droughty.
Bd: Bankard	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.
BeB: Bayard	Severe: cutbanks cave.	Slight	Slight	Slight	Moderate: frost action.	Slight.
Bo: Boel	Severe: cutbanks cave, wetness.	Severe: flooding.	Severe: flooding, wetness.	Severe: flooding.	Moderate: wetness, flooding, frost action.	Moderate: wetness, droughty.
Bs, BtB: Bridget	Slight	Slight	Slight	Slight	Moderate: low strength.	Slight.
ChB: Chappell	Severe: cutbanks cave.	Slight	Slight	Slight	Slight	Moderate: droughty.
Cu: Cullison	Severe: wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: low strength, wetness.	Severe: wetness.
Cz: Cullison	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: low strength, ponding.	Severe: ponding.
DfE: Dix	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: droughty, slope.
DsG*:						
Dix	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: droughty, slope.

See footnote at end of table.

TABLE 12.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
DsG*:						
Sully	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Sarben	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Dt, DtB, Du, DuB-- Duroc	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, low strength.	Slight.
Fu*. Fluvaquents	Severe: cutbanks cave, ponding.	Severe: flooding, ponding.	Severe: flooding, ponding.	Severe: flooding, ponding.	Severe: ponding, flooding.	Severe: ponding, flooding.
Go Gothenburg	Severe: cutbanks cave, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: wetness, flooding.	Severe: wetness, droughty.
IpB Ipage	Severe: cutbanks cave.	Slight	Moderate: wetness.	Slight	Moderate: frost action.	Severe: droughty.
Ja Janise	Severe: cutbanks cave, wetness.	Severe: flooding.	Severe: flooding, wetness.	Severe: flooding.	Severe: flooding, frost action.	Severe: excess sodium.
Jd Janise	Slight	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: flooding, frost action.	Severe: excess sodium.
KeB Keith	Slight	Slight	Slight	Slight	Moderate: low strength, frost action.	Slight.
KeC Keith	Slight	Slight	Slight	Moderate: slope.	Moderate: low strength, frost action.	Slight.
Ku, KuB Kuma	Slight	Moderate: shrink-swell.	Slight	Moderate: shrink-swell.	Severe: low strength.	Slight.
La Lawet	Severe: cutbanks cave, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: frost action.	Moderate: wetness.
Le Lex	Severe: cutbanks cave, wetness.	Severe: flooding.	Severe: flooding, wetness.	Severe: flooding.	Severe: low strength, frost action.	Moderate: wetness.
Lp Lodgepole	Severe: cutbanks cave, ponding.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: shrink-swell, low strength, ponding.	Severe: ponding.
Ma Marlake	Severe: cutbanks cave, ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.

See footnote at end of table.

TABLE 12.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
Me---------------- Merrick	Moderate: wetness.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: flooding, frost action.	Slight.
No---------------- Norwest	Severe: cutbanks cave, wetness.	Severe: flooding.	Severe: flooding, wetness.	Severe: flooding.	Severe: low strength, frost action.	Moderate: wetness.
Pp*--------------- Pits and dumps	Severe: cutbanks cave, slope.	Severe: flooding, slope.	Severe: flooding, slope.	Severe: flooding, slope.	Severe: slope.	Severe: small stones, droughty, slope.
Pt---------------- Platte	Severe: cutbanks cave, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding.	Moderate: wetness, droughty, flooding.
RtB--------------- Rosebud	Moderate: depth to rock.	Slight---------	Moderate: depth to rock.	Slight---------	Moderate: frost action.	Moderate: depth to rock.
RtD--------------- Rosebud	Moderate: depth to rock.	Slight---------	Moderate: depth to rock.	Moderate: slope.	Moderate: frost action.	Moderate: depth to rock.
SaB--------------- Sarben	Severe: cutbanks cave.	Slight---------	Slight---------	Slight---------	Slight---------	Slight.
SaC, SaD---------- Sarben	Severe: cutbanks cave.	Slight---------	Slight---------	Moderate: slope.	Slight---------	Slight.
SaE--------------- Sarben	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: slope.
Sb, SbB----------- Satanta	Severe: cutbanks cave.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, low strength.	Slight.
SbC--------------- Satanta	Severe: cutbanks cave.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Moderate: shrink-swell, low strength.	Slight.
ScD*:						
Satanta----------	Severe: cutbanks cave.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Moderate: shrink-swell, low strength.	Slight.
Dix--------------	Severe: cutbanks cave.	Slight---------	Slight---------	Moderate: slope.	Slight---------	Severe: droughty.
SfD--------------- Sully	Slight---------	Slight---------	Slight---------	Moderate: slope.	Slight---------	Slight.
SfG--------------- Sully	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
SkE*:						
Sully------------	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: slope.
Dix--------------	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Severe: droughty.

See footnote at end of table.

TABLE 12.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
SmE2*:						
Sully	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: slope.
McConaughy	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope, frost action.	Moderate: slope.
SmF*:						
Sully	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
McConaughy	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope, frost action.	Moderate: slope.
TaG*:						
Tassel	Severe: depth to rock, slope.	Severe: slope.	Severe: depth to rock, slope.	Severe: slope.	Severe: slope.	Severe: slope, depth to rock.
Otero	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Rock outcrop	Severe: depth to rock, slope.	Severe: slope.	Severe: depth to rock, slope.	Severe: slope.	Severe: slope.	Severe: slope, thin layer.
VdB: Valent	Severe: cutbanks cave.	Slight	Slight	Slight	Slight	Moderate: droughty.
VdD: Valent	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Slight	Moderate: droughty.
VdE: Valent	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
VdF*:						
Valent	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Valent	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
VgG: Valent	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
VtG*:						
Valent	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: droughty, slope.
Tassel	Severe: depth to rock, slope.	Severe: slope.	Severe: depth to rock, slope.	Severe: slope.	Severe: slope.	Severe: slope, depth to rock.

See footnote at end of table.

TABLE 12.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
VtG*:						
Rock outcrop-----	Severe: depth to rock, slope.	Severe: slope.	Severe: depth to rock, slope.	Severe: slope.	Severe: slope.	Severe: slope, thin layer.
VwB--------------- Vetal	Severe: cutbanks cave.	Slight---------	Slight---------	Slight---------	Moderate: frost action.	Slight.
Wa---------------- Wann	Severe: cutbanks cave, wetness.	Severe: flooding.	Severe: flooding, wetness.	Severe: flooding.	Severe: frost action.	Moderate: wetness.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 13.--SANITARY FACILITIES

(Some terms that describe restrictive soil features are defined in the "Glossary." See text for definitions of "slight," "good," and other terms. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
Ad: Alda	Severe: flooding, wetness, poor filter.	Severe: seepage, flooding, wetness.	Severe: flooding, seepage, wetness.	Severe: flooding, seepage, wetness.	Poor: seepage, too sandy.
AwF*:					
Altvan	Severe: poor filter.	Severe: seepage, slope.	Severe: too sandy.	Moderate: slope.	Poor: seepage, too sandy.
Dix	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, small stones.
Bb, Bc: Bankard	Severe: poor filter.	Severe: seepage.	Severe: too sandy.	Moderate: flooding.	Poor: seepage, too sandy.
Bd: Bankard	Severe: flooding, poor filter.	Severe: seepage, flooding.	Severe: flooding, too sandy.	Severe: flooding.	Poor: seepage, too sandy.
BeB: Bayard	Slight	Severe: seepage.	Severe: seepage.	Severe: seepage.	Good.
Bo: Boel	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness.	Severe: seepage, wetness.	Poor: seepage, too sandy.
Bs: Bridget	Moderate: percs slowly.	Moderate: seepage.	Slight	Slight	Good.
BtB: Bridget	Moderate: percs slowly.	Moderate: seepage, slope.	Slight	Slight	Good.
ChB: Chappell	Severe: poor filter.	Severe: seepage.	Severe: too sandy.	Slight	Poor: seepage, too sandy, small stones.
Cu: Cullison	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
Cz: Cullison	Severe: ponding.	Severe: seepage, ponding.	Severe: seepage, ponding.	Severe: seepage, ponding.	Poor: ponding.
DfE: Dix	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, small stones.

See footnote at end of table.

TABLE 13.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
DsG*:					
Dix	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, small stones.
Sully	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
Sarben	Severe: slope.	Severe: seepage, slope.	Severe: seepage, slope.	Severe: seepage, slope.	Poor: slope.
Dt: Duroc	Moderate: percs slowly.	Moderate: seepage.	Slight	Slight	Good.
DtB: Duroc	Moderate: percs slowly.	Moderate: seepage, slope.	Slight	Slight	Good.
Du: Duroc	Moderate: percs slowly.	Moderate: seepage.	Slight	Slight	Good.
DuB: Duroc	Moderate: percs slowly.	Moderate: seepage, slope.	Slight	Slight	Good.
Fu*: Fluvaquents	Severe: flooding, ponding.	Severe: seepage, flooding, ponding.	Severe: flooding, ponding.	Severe: flooding, seepage, ponding.	Poor: ponding.
Go: Gothenburg	Severe: flooding, wetness, poor filter.	Severe: seepage, flooding, wetness.	Severe: flooding, seepage, wetness.	Severe: flooding, seepage, wetness.	Poor: seepage, too sandy, wetness.
IpB: Ipage	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy.
Ja: Janise	Severe: flooding, wetness.	Severe: seepage, flooding, wetness.	Severe: flooding, seepage, wetness.	Severe: flooding, wetness.	Poor: excess sodium.
Jd: Janise	Moderate: flooding, percs slowly.	Moderate: seepage.	Severe: excess sodium, excess salt.	Moderate: flooding.	Poor: excess sodium.
KeB, KeC: Keith	Moderate: percs slowly.	Moderate: seepage, slope.	Slight	Slight	Good.
Ku: Kuma	Moderate: percs slowly.	Moderate: seepage.	Moderate: too clayey.	Slight	Fair: too clayey.
KuB: Kuma	Moderate: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight	Fair: too clayey.

See footnote at end of table.

TABLE 13.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
La------------------ Lawet	Severe: wetness, percs slowly.	Severe: seepage, wetness.	Severe: seepage, wetness.	Severe: wetness.	Poor: wetness.
Le------------------ Lex	Severe: wetness, percs slowly.	Severe: seepage, wetness.	Severe: seepage, wetness.	Severe: seepage, wetness.	Poor: seepage, too sandy.
Lp------------------ Lodgepole	Severe: ponding, percs slowly.	Severe: seepage, ponding.	Severe: seepage, ponding, too clayey.	Severe: ponding.	Poor: too clayey, hard to pack, ponding.
Ma------------------ Marlake	Severe: ponding, poor filter.	Severe: seepage, ponding.	Severe: seepage, ponding, too sandy.	Severe: seepage, ponding.	Poor: seepage, too sandy, ponding.
Me------------------ Merrick	Moderate: flooding, wetness, percs slowly.	Moderate: seepage, wetness.	Severe: wetness.	Moderate: flooding, wetness.	Fair: too clayey.
No------------------ Norwest	Severe: wetness.	Severe: seepage, wetness.	Severe: seepage, wetness.	Severe: seepage, wetness.	Fair: too clayey, too sandy, wetness.
Pp*----------------- Pits and dumps	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, small stones.
Pt------------------ Platte	Severe: flooding, wetness, poor filter.	Severe: seepage, flooding, wetness.	Severe: flooding, seepage, wetness.	Severe: flooding, seepage, wetness.	Poor: seepage, too sandy, wetness.
RtB, RtD------------ Rosebud	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Slight-----------	Poor: depth to rock.
SaB, SaC------------ Sarben	Slight-----------	Severe: seepage.	Severe: seepage.	Severe: seepage.	Good.
SaD----------------- Sarben	Slight-----------	Severe: seepage, slope.	Severe: seepage.	Severe: seepage.	Good.
SaE----------------- Sarben	Moderate: slope.	Severe: seepage, slope.	Severe: seepage.	Severe: seepage.	Fair: slope.
Sb, SbB, SbC-------- Satanta	Moderate: percs slowly.	Severe: seepage.	Slight-----------	Slight-----------	Good.
ScD*:					
Satanta------------	Moderate: percs slowly.	Severe: seepage.	Slight-----------	Slight-----------	Good.

See footnote at end of table.

TABLE 13.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
ScD*:					
Dix	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
SfD Sully	Moderate: percs slowly.	Severe: slope.	Slight	Slight	Good.
SfG Sully	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
SkE*:					
Sully	Moderate: percs slowly, slope.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope.
Dix	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
SmE2*:					
Sully	Moderate: percs slowly, slope.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope.
McConaughy	Moderate: percs slowly, slope.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope.
SmF*:					
Sully	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
McConaughy	Moderate: percs slowly, slope.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope.
TaG*:					
Tassel	Severe: depth to rock, slope.	Severe: seepage, depth to rock, slope.	Severe: depth to rock, slope.	Severe: slope.	Poor: depth to rock, slope.
Otero	Severe: slope.	Severe: seepage, slope.	Severe: slope.	Severe: slope.	Poor: slope.
Rock outcrop	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Poor: area reclaim, slope.
VdB, VdD Valent	Severe: poor filter.	Severe: seepage.	Severe: too sandy.	Slight	Poor: seepage, too sandy.
VdE Valent	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: slope, too sandy.	Severe: slope.	Poor: seepage, too sandy, slope.

See footnote at end of table.

TABLE 13.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
VdF*:					
Valent	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: slope, too sandy.	Severe: slope.	Poor: seepage, too sandy, slope.
Valent	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: slope, too sandy.	Severe: slope.	Poor: seepage, too sandy, slope.
VgG: Valent	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: slope, too sandy.	Severe: slope.	Poor: seepage, too sandy, slope.
VtG*:					
Valent	Severe: poor filter.	Severe: seepage, slope.	Severe: too sandy.	Moderate: slope.	Poor: seepage, too sandy.
Tassel	Severe: depth to rock, slope.	Severe: seepage, depth to rock, slope.	Severe: depth to rock, slope.	Severe: slope.	Poor: depth to rock, slope.
Rock outcrop	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Poor: area reclaim, slope.
VwB: Vetal	Slight	Severe: seepage.	Severe: seepage.	Severe: seepage.	Fair: thin layer.
Wa: Wann	Severe: wetness.	Severe: seepage, wetness.	Severe: seepage, wetness.	Severe: seepage, wetness.	Fair: wetness, thin layer.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 14.--CONSTRUCTION MATERIALS

(Some terms that describe restrictive soil features are defined in the "Glossary." See text for definitions of "good," "fair," and other terms. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
Ad------------------- Alda	Fair: wetness.	Probable-------------	Probable-------------	Fair: small stones, area reclaim, thin layer.
AwF*:				
Altvan---------------	Good-----------------	Probable-------------	Improbable: too sandy.	Fair: small stones, area reclaim, thin layer.
Dix------------------	Fair: slope.	Probable-------------	Probable-------------	Poor: area reclaim, too sandy, small stones.
Bb, Bc--------------- Bankard	Good-----------------	Probable-------------	Probable-------------	Poor: too sandy, small stones.
Bd------------------- Bankard	Good-----------------	Improbable: thin layer.	Improbable: too sandy.	Poor: too sandy, small stones, area reclaim.
BeB------------------ Bayard	Good-----------------	Improbable: excess fines.	Improbable: excess fines.	Fair: too sandy, small stones.
Bo------------------- Boel	Fair: wetness.	Probable-------------	Improbable: too sandy.	Poor: too sandy.
Bs, BtB-------------- Bridget	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
ChB------------------ Chappell	Good-----------------	Probable-------------	Probable-------------	Poor: small stones, area reclaim.
Cu------------------- Cullison	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
Cz------------------- Cullison	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
DfE------------------ Dix	Fair: slope.	Probable-------------	Probable-------------	Poor: area reclaim, too sandy, small stones.

See footnote at end of table.

TABLE 14.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
DsG*:				
Dix	Poor: slope.	Probable	Probable	Poor: area reclaim, too sandy, small stones.
Sully	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
Sarben	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
Dt, DtB, Du, DuB Duroc	Fair: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
Fu* Fluvaquents	Poor: wetness.	Probable	Improbable: too sandy.	Poor: too sandy, wetness.
Go Gothenburg	Poor: wetness.	Probable	Probable	Poor: small stones, wetness.
IpB Ipage	Good	Probable	Improbable: too sandy.	Poor: too sandy.
Ja Janise	Fair: wetness.	Probable	Improbable: too sandy.	Poor: excess sodium.
Jd Janise	Good	Improbable: excess fines.	Improbable: excess fines.	Poor: excess sodium.
KeB, KeC Keith	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
Ku, KuB Kuma	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
La Lawet	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
Le Lex	Fair: wetness.	Probable	Probable	Fair: small stones, area reclaim.
Lp Lodgepole	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, wetness.
Ma Marlake	Poor: wetness.	Probable	Improbable: too sandy.	Poor: too sandy, wetness.
Me Merrick	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
No Norwest	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.

See footnote at end of table.

TABLE 14.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
Pp*: Pits and dumps	Fair: slope.	Probable	Probable	Poor: area reclaim, too sandy, small stones.
Pt: Platte	Fair: wetness.	Probable	Probable	Poor: area reclaim, too sandy, small stones.
RtB, RtD: Rosebud	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Fair: depth to rock, small stones.
SaB, SaC, SaD: Sarben	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: too sandy.
SaE: Sarben	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: too sandy, slope.
Sb, SbB, SbC: Satanta	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
ScD*:				
Satanta	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
Dix	Good	Probable	Probable	Poor: area reclaim, too sandy, small stones.
SfD: Sully	Good	Improbable: excess fines.	Improbable: excess fines.	Good.
SfG: Sully	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
SkE*:				
Sully	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: slope.
Dix	Good	Probable	Probable	Poor: area reclaim, too sandy, small stones.
SmE2*:				
Sully	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: slope.
McConaughy	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: slope.
SmF*:				
Sully	Fair: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
McConaughy	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: slope.

See footnote at end of table.

TABLE 14.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
TaG*:				
Tassel	Poor: depth to rock, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, slope.
Otero	Fair: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
Rock outcrop	Poor: area reclaim, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, slope.
VdB, VdD Valent	Good	Probable	Improbable: too sandy.	Poor: too sandy.
VdE Valent	Fair: slope.	Probable	Improbable: too sandy.	Poor: too sandy, slope.
VdF*:				
Valent	Fair: slope.	Probable	Improbable: too sandy.	Poor: too sandy, slope.
Valent	Poor: slope.	Probable	Improbable: too sandy.	Poor: too sandy, slope.
VgG Valent	Poor: slope.	Probable	Improbable: too sandy.	Poor: too sandy, slope.
VtG*:				
Valent	Good	Probable	Improbable: too sandy.	Poor: too sandy.
Tassel	Poor: depth to rock, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, slope.
Rock outcrop	Poor: area reclaim, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, slope.
VwB Vetal	Good	Improbable: excess fines.	Improbable: excess fines.	Good.
Wa Wann	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 15.--WATER MANAGEMENT

(Some terms that describe restrictive soil features are defined in the "Glossary." See text for definitions of "slight," "moderate," and "severe." The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Limitations for-- Pond reservoir areas	Limitations for-- Embankments, dikes, and levees	Limitations for-- Aquifer-fed excavated ponds	Features affecting-- Drainage	Features affecting-- Irrigation	Features affecting-- Terraces and diversions	Features affecting-- Grassed waterways
Ad: Alda	Severe: seepage.	Severe: seepage, piping.	Severe: cutbanks cave.	Flooding, frost action, cutbanks cave.	Wetness, soil blowing, flooding.	Wetness, too sandy, soil blowing.	Favorable.
AwF*:							
Altvan	Severe: seepage, slope.	Severe: seepage.	Severe: no water.	Deep to water	Slope	Slope, too sandy.	Too arid, slope.
Dix	Severe: seepage, slope.	Severe: seepage.	Severe: no water.	Deep to water	Slope, droughty.	Slope, too sandy.	Too arid, slope, droughty.
Bb, Bc: Bankard	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water	Droughty, fast intake.	Too sandy, soil blowing.	Too arid, droughty.
Bd: Bankard	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water	Droughty, fast intake.	Too sandy, soil blowing.	Too arid, droughty, rooting depth.
BeB: Bayard	Severe: seepage.	Severe: piping.	Severe: no water.	Deep to water	Soil blowing	Soil blowing	Too arid.
Bo: Boel	Severe: seepage.	Severe: seepage, piping, wetness.	Severe: cutbanks cave.	Cutbanks cave	Wetness, droughty, fast intake.	Wetness, too sandy, soil blowing.	Droughty, rooting depth.
Bs, BtB: Bridget	Moderate: seepage.	Severe: piping.	Severe: no water.	Deep to water	Favorable	Erodes easily	Too arid, erodes easily.
ChB: Chappell	Severe: seepage.	Severe: seepage.	Severe: no water.	Deep to water	Droughty	Too sandy, soil blowing.	Too arid, droughty.
Cu: Cullison	Moderate: seepage.	Severe: wetness.	Moderate: slow refill.	Favorable	Wetness	Wetness	Wetness.
Cz: Cullison	Severe: seepage.	Severe: piping, ponding.	Moderate: slow refill.	Ponding	Ponding	Ponding	Wetness.

See footnote at end of table.

TABLE 15.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
DfE---------------- Dix	Severe: seepage, slope.	Severe: seepage.	Severe: no water.	Deep to water	Slope, droughty.	Slope, too sandy.	Too arid, slope, droughty.
DsG*:							
Dix---------------	Severe: seepage, slope.	Severe: seepage.	Severe: no water.	Deep to water	Slope, droughty.	Slope, too sandy.	Too arid, slope, droughty.
Sully------------	Severe: slope.	Severe: piping.	Severe: no water.	Deep to water	Slope, erodes easily.	Slope, erodes easily.	Slope, erodes easily.
Sarben-----------	Severe: seepage, slope.	Severe: piping.	Severe: no water.	Deep to water	Slope, fast intake, soil blowing.	Slope, soil blowing.	Slope.
Dt, DtB, Du, DuB-- Duroc	Moderate: seepage.	Severe: piping.	Severe: no water.	Deep to water	Favorable------	Erodes easily	Erodes easily.
Fu*--------------- Fluvaquents	Severe: seepage.	Severe: seepage, ponding.	Slight---------	Ponding, flooding.	Ponding, droughty, rooting depth.	Ponding, too sandy.	Wetness, droughty, rooting depth.
Go---------------- Gothenburg	Severe: seepage.	Severe: seepage, piping, wetness.	Severe: cutbanks cave.	Flooding, cutbanks cave.	Wetness, droughty, fast intake.	Wetness, too sandy, soil blowing.	Wetness, droughty.
IpB--------------- Ipage	Severe: seepage.	Severe: seepage, piping.	Severe: cutbanks cave.	Deep to water	Droughty, fast intake.	Too sandy, soil blowing.	Droughty.
Ja---------------- Janise	Severe: seepage.	Severe: piping, excess sodium.	Severe: slow refill, cutbanks cave.	Flooding, frost action, cutbanks cave.	Wetness, flooding, excess sodium.	Erodes easily, wetness.	Excess sodium, erodes easily.
Jd---------------- Janise	Moderate: seepage.	Severe: piping, excess sodium, excess salt.	Severe: no water.	Deep to water	Erodes easily, excess sodium.	Erodes easily	Excess sodium, erodes easily.
KeB--------------- Keith	Moderate: seepage.	Severe: piping.	Severe: no water.	Deep to water	Favorable------	Erodes easily	Too arid, erodes easily.
KeC--------------- Keith	Moderate: seepage, slope.	Severe: piping.	Severe: no water.	Deep to water	Slope----------	Erodes easily	Too arid, erodes easily.

See footnote at end of table.

TABLE 15.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Limitations for-- Embankments, dikes, and levees	Limitations for-- Aquifer-fed excavated ponds	Features affecting-- Drainage	Features affecting-- Irrigation	Features affecting-- Terraces and diversions	Features affecting-- Grassed waterways
Ku, KuB: Kuma	Moderate: seepage.	Severe: piping.	Severe: no water.	Deep to water	Favorable	Erodes easily	Erodes easily.
La: Lawet	Severe: seepage.	Severe: wetness.	Severe: slow refill, cutbanks cave.	Frost action	Wetness	Wetness	Wetness.
Le: Lex	Severe: seepage.	Severe: seepage, piping, wetness.	Severe: slow refill, cutbanks cave.	Frost action, cutbanks cave.	Wetness	Wetness, too sandy.	Favorable.
Lp: Lodgepole	Severe: seepage.	Severe: thin layer, ponding.	Severe: no water.	Ponding, percs slowly, frost action.	Ponding, percs slowly.	Erodes easily, ponding.	Wetness, erodes easily, percs slowly.
Ma: Marlake	Severe: seepage.	Severe: seepage, piping, ponding.	Severe: cutbanks cave.	Ponding, cutbanks cave.	Ponding, droughty.	Ponding, too sandy.	Wetness, droughty.
Me: Merrick	Moderate: seepage.	Severe: piping.	Moderate: deep to water, slow refill.	Deep to water	Favorable	Favorable	Favorable.
No: Norwest	Severe: seepage.	Severe: seepage, piping, wetness.	Severe: cutbanks cave.	Frost action, cutbanks cave.	Wetness	Wetness, too sandy.	Favorable.
Pp*: Pits and dumps	Severe: seepage, slope.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Slope, too sandy.	Slope, droughty, rooting depth.
Pt: Platte	Severe: seepage.	Severe: seepage, piping, wetness.	Severe: cutbanks cave.	Flooding, cutbanks cave.	Wetness, droughty.	Wetness, too sandy.	Wetness, droughty, rooting depth.
RtB: Rosebud	Moderate: seepage, depth to rock.	Severe: piping.	Severe: no water.	Deep to water	Depth to rock	Depth to rock	Too arid, depth to rock.
RtD: Rosebud	Moderate: seepage, depth to rock, slope.	Severe: piping.	Severe: no water.	Deep to water	Slope, depth to rock.	Depth to rock	Too arid, depth to rock.

See footnote at end of table.

TABLE 15.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
SaB--------------- Sarben	Severe: seepage.	Severe: piping.	Severe: no water.	Deep to water	Fast intake, soil blowing.	Soil blowing---	Favorable.
SaC, SaD---------- Sarben	Severe: seepage.	Severe: piping.	Severe: no water.	Deep to water	Slope, fast intake, soil blowing.	Soil blowing---	Favorable.
SaE--------------- Sarben	Severe: seepage, slope.	Severe: piping.	Severe: no water.	Deep to water	Slope, fast intake, soil blowing.	Slope, soil blowing.	Slope.
Sb, SbB----------- Satanta	Severe: seepage.	Severe: thin layer.	Severe: no water.	Deep to water	Favorable------	Favorable------	Too arid.
SbC--------------- Satanta	Severe: seepage.	Severe: thin layer.	Severe: no water.	Deep to water	Slope----------	Favorable------	Too arid.
ScD*:							
Satanta----------	Severe: seepage.	Severe: thin layer.	Severe: no water.	Deep to water	Slope----------	Favorable------	Too arid.
Dix--------------	Severe: seepage.	Severe: seepage.	Severe: no water.	Deep to water	Slope, droughty.	Too sandy------	Too arid, droughty.
SfD--------------- Sully	Moderate: seepage, slope.	Severe: piping.	Severe: no water.	Deep to water	Erodes easily	Erodes easily	Erodes easily.
SfG--------------- Sully	Severe: slope.	Severe: piping.	Severe: no water.	Deep to water	Slope, erodes easily.	Slope, erodes easily.	Slope, erodes easily.
SkE*:							
Sully------------	Severe: slope.	Severe: piping.	Severe: no water.	Deep to water	Slope, erodes easily.	Slope, erodes easily.	Slope, erodes easily.
Dix--------------	Severe: seepage, slope.	Severe: seepage.	Severe: no water.	Deep to water	Slope, droughty.	Slope, too sandy.	Too arid, slope, droughty.
SmE2*, SmF*:							
Sully------------	Severe: slope.	Severe: piping.	Severe: no water.	Deep to water	Slope, erodes easily.	Slope, erodes easily.	Slope, erodes easily.
McConaughy-------	Severe: slope.	Severe: piping.	Severe: no water.	Deep to water	Slope----------	Slope, erodes easily.	Too arid, slope, erodes easily.

See footnote at end of table.

TABLE 15.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
TaG*:							
Tassel	Severe: depth to rock, slope.	Slight	Severe: no water.	Deep to water	Slope, soil blowing, depth to rock.	Slope, depth to rock, erodes easily.	Too arid, slope, erodes easily.
Otero	Severe: seepage, slope.	Severe: piping.	Severe: no water.	Deep to water	Slope, soil blowing.	Slope, erodes easily, soil blowing.	Too arid, slope, erodes easily.
Rock outcrop	Severe: depth to rock, slope.	Severe: area reclaim.	Severe: no water.	Deep to water	Depth to rock, slope.	Slope, depth to rock.	Slope, depth to rock.
VdB Valent	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water	Droughty, fast intake.	Too sandy, soil blowing.	Too arid, droughty.
VdD Valent	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Too sandy, soil blowing.	Too arid, droughty.
VdE Valent	Severe: seepage, slope.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Slope, too sandy, soil blowing.	Too arid, slope, droughty.
VdF*:							
Valent	Severe: seepage, slope.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Slope, too sandy, soil blowing.	Too arid, slope, droughty.
Valent	Severe: seepage, slope.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Slope, too sandy, soil blowing.	Too arid, slope, droughty.
VgG Valent	Severe: seepage, slope.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Slope, too sandy, soil blowing.	Too arid, slope, droughty.
VtG*:							
Valent	Severe: seepage, slope.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Slope, too sandy, soil blowing.	Too arid, slope, droughty.
Tassel	Severe: depth to rock, slope.	Slight	Severe: no water.	Deep to water	Slope, soil blowing, depth to rock.	Slope, depth to rock.	Too arid, slope.

See footnote at end of table.

TABLE 15.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--			Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Irrigation	Terraces and diversions	Grassed waterways
VtG*:							
Rock outcrop-----	Severe: depth to rock, slope.	Severe: area reclaim.	Severe: no water.	Deep to water	Depth to rock, slope.	Slope, depth to rock.	Slope, depth to rock.
VwB---------------- Vetal	Severe: seepage.	Severe: piping.	Severe: no water.	Deep to water	Fast intake, soil blowing.	Soil blowing---	Favorable.
Wa----------------- Wann	Severe: seepage.	Severe: piping, wetness.	Severe: cutbanks cave.	Frost action---	Wetness, soil blowing.	Wetness, soil blowing.	Favorable.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 16.--ENGINEERING INDEX PROPERTIES

(The symbol < means less than; > means more than. Absence of an entry indicates that data were not estimated)

Soil name and map symbol	Depth	USDA texture	Classification		Fragments 3-10 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
Ad--------------- Alda	0-17	Fine sandy loam	SM, SC-SM	A-2, A-4	0	90-100	85-100	70-100	30-50	<20	NP-5
	17-32	Fine sandy loam, sandy loam, very fine sandy loam.	SM, SC-SM	A-2, A-4	0	95-100	95-100	70-100	30-50	<26	NP-7
	32-60	Coarse sand, gravelly sand.	SP, SM, SP-SM	A-1, A-2, A-3	0	70-100	65-95	30-95	2-15	<20	NP
AwF*: Altvan-----------	0-5	Loam-------------	ML	A-4	0	100	100	85-100	60-90	25-35	2-10
	5-23	Clay loam, loam, sandy clay loam.	CL	A-6, A-7	0	95-100	95-100	85-100	70-80	35-50	15-25
	23-34	Loam, fine sandy loam, silt loam.	ML	A-4	0	90-100	85-100	60-95	50-75	25-35	2-10
	34-60	Gravelly sand, gravelly coarse sand, coarse sand.	SP, SP-SM	A-1	0	75-95	55-90	25-35	0-10	---	NP
Dix--------------	0-4	Gravelly loam----	SM, GM	A-4, A-2	0	50-80	50-75	40-70	30-50	<35	NP-10
	4-60	Very gravelly coarse sand, very gravelly sand, gravelly coarse sand.	SP, GP, SP-SM, GP-GM	A-1	0-5	30-60	25-50	10-35	0-10	---	NP
Bb--------------- Bankard	0-4	Sand-------------	SM, SP-SM	A-2, A-1, A-3	0	100	80-100	40-60	5-15	---	NP
	4-60	Stratified gravelly sand to loam.	SM, SP-SM	A-2, A-1, A-3	0-5	65-100	60-85	40-75	5-35	---	NP
Bc--------------- Bankard	0-8	Loamy sand-------	SM	A-2	0	100	80-100	50-75	20-30	---	NP
	8-60	Stratified gravelly sand to loam.	SM, SP-SM	A-2, A-1, A-3	0-5	65-100	60-85	40-75	5-35	---	NP
Bd--------------- Bankard	0-6	Loamy sand-------	SM	A-2	0	95-100	80-100	50-75	15-25	---	NP
	6-18	Fine sand, sand, loamy sand.	SP-SM, SM	A-2, A-3, A-1	0-5	80-100	75-100	40-70	5-35	---	NP
	18-60	Gravelly sand, very gravelly loamy sand, very gravelly sand.	GP, SP, GP-GM, SP-SM	A-1, A-2, A-3	0-5	35-75	35-75	20-60	0-15	---	NP
BeB-------------- Bayard	0-16	Very fine sandy loam.	SM, ML, SC-SM, CL-ML	A-2, A-4	0	90-100	90-100	75-95	30-65	20-40	3-10
	16-60	Fine sandy loam, loamy very fine sand, very fine sandy loam.	ML, SM, SC-SM, CL-ML	A-2, A-4	0	90-100	80-100	55-95	30-65	20-40	3-10
Bo--------------- Boel	0-13	Loamy fine sand	SM, SP	A-2, A-3	0	100	95-100	85-95	0-35	---	NP
	13-60	Fine sand, loamy fine sand, coarse sand.	SP, SM	A-2, A-3	0	100	95-100	85-95	0-25	---	NP

See footnote at end of table.

TABLE 16.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Frag- ments 3-10 inches	Percentage passing sieve number-- 4	10	40	200	Liquid limit	Plas- ticity index
	In				Pct					Pct	
Bs---------------- Bridget	0-12	Silt loam--------	ML, CL-ML, CL	A-4	0	95-100	95-100	80-100	65-90	20-35	3-10
	12-20	Very fine sandy loam, silt loam.	ML, CL-ML, CL	A-4	0	95-100	95-100	85-100	80-100	20-35	3-10
	20-60	Very fine sandy loam, silt loam, loam.	ML, CL-ML, CL	A-4	0	95-100	95-100	85-100	80-100	20-35	3-10
BtB--------------- Bridget	0-16	Loam-------------	ML, CL-ML, CL	A-4	0	95-100	95-100	75-100	55-75	20-35	3-10
	16-60	Very fine sandy loam, silt loam, loam.	ML, CL-ML, CL	A-4	0	95-100	95-100	85-100	80-100	20-35	3-10
ChB--------------- Chappell	0-7	Fine sandy loam	SM, SC-SM	A-2, A-4	0	90-100	90-100	60-85	30-50	18-30	NP-7
	7-30	Sandy loam, fine sandy loam, coarse sandy loam.	SM, SC-SM	A-2, A-4	0	90-100	90-100	60-80	30-50	18-30	NP-7
	30-60	Gravelly coarse sand, very gravelly coarse sand.	SP, GP, SP-SM, GP-GM	A-1	0-5	35-65	30-60	5-30	0-15	---	NP
Cu---------------- Cullison	0-18	Fine sandy loam	SM, ML, SC-SM, CL-ML	A-4	0	100	100	70-90	40-60	<25	NP-5
	18-24	Loam, sandy clay loam, clay loam.	CL, SC	A-4, A-6, A-7	0	100	100	70-100	40-85	30-50	8-24
	24-60	Loam, sandy clay loam, clay loam.	CL, SC	A-4, A-6, A-7	0	100	100	70-100	40-85	30-50	8-24
Cz---------------- Cullison	0-19	Loam-------------	CL, SC	A-4, A-6	0	100	100	85-100	45-85	20-40	7-20
	19-28	Loam, sandy clay loam, clay loam.	CL, SC	A-4, A-6, A-7	0	100	100	70-100	45-85	30-50	8-24
	28-60	Loam, sandy clay loam, clay loam.	SC, CL	A-4, A-6, A-7	0	100	100	70-100	45-85	30-50	8-24
DfE--------------- Dix	0-4	Gravelly loam----	SM, GM	A-4, A-2	0	50-80	50-75	40-70	30-50	<35	NP-10
	4-10	Gravelly loamy coarse sand, very gravelly sand, very gravelly loamy coarse sand.	SP, SP-SM, SM, GP	A-1, A-2, A-3	0	40-90	30-85	15-60	4-20	---	NP
	10-60	Very gravelly coarse sand, very gravelly sand, gravelly coarse sand.	SP, GP, SP-SM, GP-GM	A-1	0-5	30-60	25-50	10-35	0-10	---	NP
DsG*: Dix--------------	0-5	Gravelly loam----	SM, GM	A-4, A-2	0	50-80	50-75	40-70	30-50	<35	NP-10
	5-60	Very gravelly coarse sand, very gravelly sand, gravelly coarse sand.	SP, GP, SP-SM, GP-GM	A-1	0-5	30-60	25-50	10-35	0-10	---	NP

See footnote at end of table.

TABLE 16.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments 3-10 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
DsG*:											
Sully-----------	0-6	Silt loam--------	ML, CL-ML, CL	A-4	0	100	100	90-100	70-90	20-30	NP-10
	6-60	Silt loam, very fine sandy loam, loam.	ML, CL-ML, CL	A-4	0	100	100	85-100	50-90	20-30	NP-10
Sarben----------	0-6	Loamy fine sand	SM	A-2	0	100	100	50-75	15-30	<20	NP
	6-15	Loamy very fine sand, fine sandy loam, very fine sandy loam.	SM, ML	A-4	0	100	100	90-100	40-65	<20	NP
	15-25	Very fine sandy loam, loamy very fine sand, fine sandy loam.	SM, ML	A-4	0	100	100	90-100	40-65	<20	NP
	25-60	Very fine sandy loam, loamy very fine sand, fine sandy loam.	SM, ML	A-4	0	100	100	90-100	40-65	<20	NP
Dt, DtB---------- Duroc	0-7	Loam-------------	CL, CL-ML	A-6, A-4	0	100	95-100	85-100	60-100	25-35	5-15
	7-36	Loam, silt loam	CL, CL-ML	A-6, A-4	0	100	95-100	85-100	70-100	25-35	5-15
	36-50	Loam, silt loam	CL, CL-ML	A-6, A-4	0	100	95-100	85-100	70-100	25-35	5-15
	50-60	Loam, silt loam	CL, CL-ML	A-6, A-4	0	100	95-100	85-100	70-100	25-35	5-15
Du, DuB---------- Duroc	0-6	Silt loam--------	CL, CL-ML	A-6, A-4	0	100	100	90-100	70-100	25-35	5-15
	6-25	Loam, silt loam	CL, CL-ML	A-6, A-4	0	100	95-100	85-100	70-100	25-35	5-15
	25-50	Loam, silt loam	CL, CL-ML	A-6, A-4	0	100	95-100	85-100	70-100	25-35	5-15
	50-60	Loam, silt loam	CL, CL-ML	A-6, A-4	0	100	95-100	85-100	70-100	25-35	5-15
Fu*-------------- Fluvaquents	0-60	Sand-------------	SM, SP-SM	A-2, A-3, A-4	0	100	100	50-70	5-40	<25	NP-5
Go--------------- Gothenburg	0-3	Loamy sand-------	SM	A-2	0	100	100	50-80	15-35	---	NP
	3-8	Fine sand, sand	SM, SP-SM, SP	A-2, A-3	0	100	80-100	65-80	0-15	---	NP
	8-60	Gravelly coarse sand, coarse sand.	SP, SM, SP-SM	A-1, A-2, A-3	0	70-95	65-95	30-65	3-15	---	NP
IpB-------------- Ipage	0-9	Fine sand--------	SM, SP-SM	A-2, A-3	0	100	100	50-100	5-30	---	NP
	9-60	Fine sand, loamy sand, sand.	SM, SP-SM, SP	A-2, A-3	0	100	95-100	50-100	2-30	---	NP
Ja--------------- Janise	0-3	Loam-------------	ML, CL-ML	A-4	0	100	100	85-95	60-75	20-30	3-10
	3-14	Loam-------------	ML, CL-ML	A-4	0	100	100	85-95	60-75	20-30	3-10
	14-28	Loam, very fine sandy loam.	ML, CL-ML	A-4	0	100	100	85-95	50-75	20-35	3-10
	28-44	Loamy very fine sand.	ML, CL-ML, SC-SM	A-4	0	100	100	90-95	40-60	20-25	3-10
	44-60	Coarse sand, sand	SM, SP-SM	A-2	0	100	100	50-70	5-15	15-20	NP-5
Jd--------------- Janise	0-7	Loam-------------	ML, CL-ML, CL	A-4, A-6	0	100	100	90-100	65-95	20-35	2-12
	7-24	Loam, silt loam, silty clay loam.	CL-ML, CL	A-4, A-6	0	100	100	95-100	80-95	25-40	5-15
	24-60	Very fine sandy loam, loam, silt loam.	ML, CL-ML, CL	A-4, A-6	0	100	100	90-100	80-90	<25	NP-12

See footnote at end of table.

TABLE 16.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Frag- ments 3-10 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plas- ticity index
	In				Pct					Pct	
KeB-------------- Keith	0-11	Loam-------------	CL, ML, CL-ML	A-4	0	100	100	85-100	85-100	20-35	2-10
	11-32	Silt loam, silty clay loam, loam.	CL	A-6, A-7	0	100	100	95-100	85-100	30-45	10-25
	32-60	Silt loam, loam, very fine sandy loam.	ML, CL, CL-ML	A-4, A-6	0	100	100	90-100	85-100	20-35	2-12
KeC-------------- Keith	0-6	Loam-------------	CL, ML, CL-ML	A-4	0	100	100	85-100	85-100	20-35	2-10
	6-26	Silt loam, silty clay loam, loam.	CL	A-6, A-7	0	100	100	95-100	85-100	30-45	10-25
	26-60	Silt loam, loam, very fine sandy loam.	ML, CL, CL-ML	A-4, A-6	0	100	100	90-100	85-100	20-35	2-12
Ku, KuB---------- Kuma	0-5	Loam-------------	ML	A-4	0	100	95-100	90-100	75-95	25-35	NP-10
	5-36	Silty clay loam, silt loam.	CL	A-6, A-7	0	100	95-100	90-100	85-95	30-45	10-25
	36-60	Silty clay loam, loam, very fine sandy loam.	CL, CL-ML, ML	A-4, A-6	0	95-100	95-100	90-100	70-95	20-40	NP-20
La--------------- Lawet	0-10	Loam-------------	CL, CL-ML	A-6, A-4	0	100	100	85-100	50-95	20-40	5-15
	10-60	Sandy clay loam, clay loam, silty clay loam.	CL, SC	A-6, A-4	0	100	100	70-100	35-75	20-35	8-20
Le--------------- Lex	0-11	Loam-------------	ML, CL, CL-ML	A-4, A-6	0	95-100	95-100	85-100	60-95	22-35	3-15
	11-24	Stratified sandy loam to silty clay loam.	CL, ML, CL-ML	A-6, A-4, A-7	0	95-100	95-100	85-100	60-90	20-45	3-25
	24-60	Gravelly sand, coarse sand.	SP, SP-SM, SM	A-2, A-1, A-3	0	60-100	60-95	30-65	3-14	<20	NP
Lp--------------- Lodgepole	0-7	Silt loam--------	CL, CL-ML, ML	A-4, A-6	0	95-100	90-100	90-100	70-95	20-40	3-20
	7-60	Silty clay loam, silty clay, clay.	CH	A-7	0	95-100	90-100	90-100	85-95	50-65	25-40
Ma--------------- Marlake	0-8	Fine sandy loam	SM, ML	A-4	0	100	100	70-85	40-55	<20	NP
	8-60	Sand, fine sand, loamy fine sand.	SM, SP-SM	A-2, A-3	0	100	100	50-80	5-35	---	NP
Me--------------- Merrick	0-25	Loam-------------	CL, CL-ML	A-4, A-6	0	100	100	85-95	60-75	25-35	5-15
	25-42	Clay loam--------	CL	A-6	0	100	100	90-100	70-80	30-40	10-20
	42-60	Loam, clay loam	CL, CL-ML	A-4, A-6	0	100	100	85-100	60-80	25-35	5-15
No--------------- Norwest	0-15	Loam-------------	CL	A-6	0	100	100	85-95	60-75	25-35	10-15
	15-34	Loam, clay loam	CL	A-6	0	100	100	85-100	65-80	25-40	10-20
	34-60	Stratified loamy sand to clay loam.	SM, SC, ML, CL-ML	A-4, A-6, A-2	0	100	95-100	50-95	15-80	<25	NP-15
Pp*-------------- Pits and dumps	0-60	Gravelly sand----	SP, SP-SM, SM, GP-GM	A-1, A-2, A-3	0-5	45-100	40-100	0-80	0-40	---	NP

See footnote at end of table.

TABLE 16.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Frag- ments 3-10 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plas- ticity index
	In				Pct					Pct	
Pt---------------- Platte	0-5	Loam	CL-ML, CL	A-4, A-6	0	100	95-100	85-100	60-95	22-35	4-15
	5-18	Very fine sandy loam, loam, fine sandy loam.	ML, CL-ML, SM, SC-SM	A-4	0	100	95-100	75-95	45-75	<20	NP-5
	18-60	Gravelly coarse sand, coarse sand, gravelly sand.	SP-SM, SM	A-1, A-2, A-3	0	70-95	50-95	25-65	5-15	<20	NP
RtB, RtD---------- Rosebud	0-6	Loam	ML, CL, CL-ML	A-4, A-6	0	95-100	90-100	80-100	55-90	24-34	3-12
	6-21	Clay loam, loam	CL	A-6, A-7	0	95-100	90-100	80-100	60-85	30-50	12-26
	21-30	Sandy loam, very fine sandy loam, loam.	SM, ML, CL-ML, SC-SM	A-4, A-6, A-2	0	95-100	80-100	60-100	30-90	20-40	2-12
	30-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
SaB, SaC, SaD, SaE-------------- Sarben	0-5	Loamy fine sand	SM	A-2	0	100	100	50-75	15-30	<20	NP
	5-11	Loamy very fine sand, fine sandy loam, very fine sandy loam.	SM, ML	A-4	0	100	100	90-100	40-65	<20	NP
	11-35	Very fine sandy loam, loamy very fine sand, fine sandy loam.	SM, ML	A-4	0	100	100	90-100	40-65	<20	NP
	35-60	Very fine sandy loam, loamy very fine sand, fine sandy loam.	SM, ML	A-4	0	100	100	90-100	40-65	<20	NP
Sb---------------- Satanta	0-6	Loam	CL, CL-ML	A-4, A-6	0	100	95-100	80-95	55-75	20-35	5-15
	6-34	Loam, clay loam, sandy clay loam.	SC, CL	A-7, A-6	0	100	95-100	75-100	45-75	30-45	10-20
	34-60	Fine sandy loam, very fine sandy loam.	ML, SM	A-4	0	100	95-100	70-95	40-60	20-30	NP-5
SbB, SbC---------- Satanta	0-6	Loam	CL, CL-ML	A-4, A-6	0	100	95-100	80-95	55-75	20-35	5-15
	6-60	Loam, clay loam, sandy clay loam.	SC, CL	A-7, A-6	0	100	95-100	75-100	45-75	30-45	10-20
ScD*:											
Satanta----------	0-6	Loam	CL, CL-ML	A-4, A-6	0	100	95-100	80-95	55-75	20-35	5-15
	6-29	Loam, clay loam, sandy clay loam.	SC, CL	A-7, A-6	0	100	95-100	75-100	45-75	30-45	10-20
	29-60	Fine sandy loam, very fine sandy loam.	ML, SM	A-4	0	100	95-100	70-95	40-60	20-30	NP-5
Dix--------------	0-4	Gravelly loam	SM, GM	A-4, A-2	0	50-80	50-75	40-70	30-50	<35	NP-10
	4-60	Very gravelly coarse sand, very gravelly sand, gravelly coarse sand.	SP, GP, SP-SM, GP-GM	A-1	0-5	30-60	25-50	10-35	0-10	---	NP

See footnote at end of table.

TABLE 16.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Frag- ments 3-10 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plas- ticity index
	In				Pct					Pct	
SfD-------------- Sully	0-5	Loam-------------	ML, CL-ML, CL	A-4	0	100	100	80-100	60-90	20-35	NP-15
	5-60	Silt loam, very fine sandy loam, loam.	ML, CL-ML, CL	A-4	0	100	100	85-100	50-90	20-30	NP-10
SfG-------------- Sully	0-6	Loam-------------	ML, CL-ML, CL	A-4	0	100	100	80-100	60-90	20-35	NP-15
	6-60	Silt loam, very fine sandy loam, loam.	ML, CL-ML, CL	A-4	0	100	100	85-100	50-90	20-30	NP-10
SkE*:											
Sully-----------	0-6	Loam-------------	ML, CL-ML, CL	A-4	0	100	100	80-100	60-90	20-35	NP-15
	6-60	Silt loam, very fine sandy loam, loam.	ML, CL-ML, CL	A-4	0	100	100	85-100	50-90	20-30	NP-10
Dix-------------	0-4	Gravelly loam----	SM, GM	A-4, A-2	0	50-80	50-75	40-70	30-50	<35	NP-10
	4-60	Very gravelly coarse sand, very gravelly sand, gravelly coarse sand.	SP, GP, SP-SM, GP-GM	A-1	0-5	30-60	25-50	10-35	0-10	---	NP
SmE2*:											
Sully-----------	0-5	Loam-------------	ML, CL-ML, CL	A-4	0	100	100	80-100	60-90	20-35	NP-15
	5-60	Silt loam, very fine sandy loam, loam.	ML, CL-ML, CL	A-4	0	100	100	85-100	50-90	20-30	NP-10
McConaughy------	0-6	Loam-------------	ML, CL-ML, CL	A-4, A-6	0	100	100	85-100	60-100	20-35	NP-12
	6-21	Loam, very fine sandy loam.	ML, CL-ML, CL	A-4, A-6	0	100	100	85-100	65-100	20-35	NP-12
	21-60	Loam, very fine sandy loam.	ML, CL-ML, CL	A-4, A-6	0	100	100	85-100	80-100	20-35	NP-12
SmF*:											
Sully-----------	0-3	Loam-------------	ML, CL-ML, CL	A-4	0	100	100	80-100	60-90	20-35	NP-15
	3-60	Silt loam, very fine sandy loam, loam.	ML, CL-ML, CL	A-4	0	100	100	85-100	50-90	20-30	NP-10
McConaughy------	0-13	Loam-------------	ML, CL-ML, CL	A-4, A-6	0	100	100	85-100	60-100	20-35	NP-12
	13-34	Loam, very fine sandy loam.	ML, CL-ML, CL	A-4, A-6	0	100	100	85-100	65-100	20-35	NP-12
	34-60	Loam, very fine sandy loam.	ML, CL-ML, CL	A-4, A-6	0	100	100	85-100	80-100	20-35	NP-12

See footnote at end of table.

TABLE 16.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Frag- ments 3-10 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plas- ticity index
	In				Pct					Pct	
TaG*:											
Tassel----------	0-7	Very fine sandy loam.	SM, ML, CL-ML, SC-SM	A-4	0	95-100	90-100	75-100	40-60	<25	NP-8
	7-15	Fine sandy loam, sandy loam, loamy very fine sand.	ML, CL-ML, SM, SC-SM	A-4, A-2	0	95-100	80-100	65-95	25-60	<25	NP-8
	15-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
Otero-----------	0-8	Very fine sandy loam.	ML	A-4	0	100	95-100	85-95	60-80	20-30	NP-5
	8-60	Very fine sandy loam, loamy very fine sand.	ML, SM	A-4	0	100	95-100	85-95	40-60	---	NP-5
Rock outcrop----	0-60	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
VdB, VdD, VdE---- Valent	0-6	Fine sand--------	SP-SM, SM	A-2, A-3	0	100	100	60-70	5-20	---	NP
	6-60	Fine sand, loamy fine sand, loamy sand.	SM, SP-SM	A-2	0	100	95-100	75-90	10-30	---	NP
VdF*:											
Valent----------	0-4	Fine sand--------	SP-SM, SM	A-2, A-3	0	100	100	60-70	5-20	---	NP
	4-60	Fine sand, loamy fine sand, loamy sand.	SM, SP-SM	A-2	0	100	95-100	75-90	10-30	---	NP
Valent----------	0-4	Fine sand--------	SP-SM, SM	A-2, A-3	0	100	100	60-70	5-20	---	NP
	4-60	Fine sand, loamy fine sand, loamy sand.	SM, SP-SM	A-2	0	100	95-100	75-90	10-30	---	NP
VgG------------- Valent	0-3	Fine sand--------	SP-SM, SM	A-2, A-3	0	100	100	60-70	5-20	---	NP
	3-60	Fine sand, loamy fine sand, loamy sand.	SM, SP-SM	A-2	0	100	95-100	75-90	10-30	---	NP
VtG*:											
Valent----------	0-5	Fine sand--------	SP-SM, SM	A-2, A-3	0	100	100	60-70	5-20	---	NP
	5-60	Fine sand, loamy fine sand, loamy sand.	SM, SP-SM	A-2	0	100	95-100	75-90	10-30	---	NP
Tassel----------	0-8	Fine sandy loam	SM, ML, CL-ML, SC-SM	A-4, A-2	0	95-100	90-100	55-100	25-55	<25	NP-8
	8-12	Fine sandy loam, sandy loam, loamy very fine sand.	ML, CL-ML, SM, SC-SM	A-4, A-2	0	95-100	80-100	65-95	25-60	<25	NP-8
Rock outcrop----	0-60	Unweathered bedrock.	---	---	---	---	---	---	---	---	---

See footnote at end of table.

TABLE 16.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Frag- ments 3-10 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plas- ticity index
	In				Pct					Pct	
VwB--------------	0-8	Loamy fine sand	SM, SC-SM	A-2	0	100	100	85-100	15-35	<25	NP-5
Vetal	8-38	Fine sandy loam, very fine sandy loam, sandy loam.	SM, ML	A-4, A-2	0	100	100	60-95	30-65	20-30	NP-7
	38-60	Loamy fine sand, fine sand, sand.	SM, SC-SM	A-2	0	100	100	85-100	15-35	<25	NP-5
Wa----------------	0-14	Fine sandy loam	SM, SC-SM	A-2, A-4	0	95-100	95-100	70-100	30-50	<25	NP-5
Wann	14-51	Sandy loam, fine sandy loam.	SM, SC-SM	A-2, A-4	0	95-100	75-100	60-100	20-50	<25	NP-5
	51-60	Stratified sandy clay loam to fine sand.	SM	A-2, A-4	0	95-100	95-100	70-100	15-40	<20	NP-3

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 17.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS

(The symbol < means less than; > means more than. Entries under "Erosion factors--T" apply to the entire profile. Entries under "Wind erodibility group" and "Organic matter" apply only to the surface layer. Absence of an entry indicates that data were not available or were not estimated)

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group	Organic matter
	In	Pct	g/cc	In/hr	In/in	pH	mmhos/cm					Pct
Ad--------------- Alda	0-17	5-12	1.40-1.60	2.0-6.0	0.16-0.18	6.6-8.4	<2	Low--------	0.20	4	3	2-4
	17-32	3-10	1.40-1.60	2.0-6.0	0.15-0.17	7.4-8.4	<2	Low--------	0.20			
	32-60	0-2	1.50-1.70	>20	0.02-0.04	6.6-8.4	<2	Low--------	0.10			
AwF*:												
Altvan-----------	0-5	16-23	1.20-1.40	0.6-2.0	0.20-0.24	6.1-7.8	<2	Low--------	0.28	4	5	1-2
	5-23	20-35	1.20-1.50	0.6-2.0	0.15-0.17	6.6-8.4	<2	Moderate	0.32			
	23-34	8-15	1.30-1.50	0.6-2.0	0.17-0.19	7.4-9.0	<2	Low--------	0.32			
	34-60	0-5	1.50-1.70	>20	0.02-0.04	7.4-9.0	<2	Low--------	0.10			
Dix--------------	0-4	5-20	1.60-1.80	0.6-2.0	0.12-0.18	6.1-7.8	<2	Low--------	0.17	2	7	1-2
	4-60	0-3	1.70-2.00	>20	0.02-0.04	6.6-8.4	<2	Low--------	0.05			
Bb--------------- Bankard	0-4	2-8	1.55-1.65	>20	0.07-0.09	7.4-8.4	<2	Low--------	0.15	5	1	.5-1
	4-60	2-10	1.55-1.65	6.0-20	0.05-0.08	7.4-8.4	<2	Low--------	0.20			
Bc--------------- Bankard	0-8	2-10	1.55-1.65	6.0-20	0.06-0.09	7.4-8.4	<2	Low--------	0.17	5	2	1-2
	8-60	2-10	1.55-1.65	6.0-20	0.05-0.08	7.4-8.4	<2	Low--------	0.20			
Bd--------------- Bankard	0-6	2-10	1.65-1.75	6.0-20	0.05-0.08	7.4-8.4	<2	Low--------	0.10	5	2	.5-1
	6-18	2-10	1.65-1.75	6.0-20	0.05-0.08	7.4-8.4	<2	Low--------	0.10			
	18-60	2-10	1.70-1.80	>20	0.05-0.06	7.4-9.0	<2	Low--------	0.10			
BeB-------------- Bayard	0-16	5-18	1.20-1.50	2.0-6.0	0.17-0.19	6.6-7.8	<2	Low--------	0.32	5	3	1-3
	16-60	5-18	1.20-1.50	2.0-6.0	0.12-0.18	7.4-8.4	<2	Low--------	0.20			
Bo--------------- Boel	0-13	2-10	1.60-1.80	6.0-20	0.10-0.12	6.6-8.4	<2	Low--------	0.17	5	2	1-2
	13-60	0-6	1.50-1.60	6.0-20	0.05-0.10	6.6-8.4	<2	Low--------	0.20			
Bs--------------- Bridget	0-12	10-20	1.20-1.40	0.6-2.0	0.18-0.24	6.6-7.8	<2	Low--------	0.32	5	5	1-3
	12-20	5-18	1.40-1.60	0.6-2.0	0.16-0.24	7.4-8.4	<2	Low--------	0.43			
	20-60	5-18	1.40-1.60	0.6-2.0	0.16-0.24	7.4-8.4	<2	Low--------	0.43			
BtB-------------- Bridget	0-16	10-20	1.25-1.45	0.6-2.0	0.17-0.22	6.6-7.8	<2	Low--------	0.28	5	5	1-3
	16-60	5-18	1.40-1.60	0.6-2.0	0.16-0.24	7.4-8.4	<2	Low--------	0.43			
ChB-------------- Chappell	0-7	5-18	1.50-1.70	2.0-6.0	0.13-0.18	6.1-7.3	<2	Low--------	0.20	4	3	1-2
	7-30	5-18	1.60-1.70	2.0-6.0	0.12-0.17	6.1-8.4	<2	Low--------	0.20			
	30-60	0-3	1.50-1.70	>20	0.02-0.04	6.6-8.4	<2	Low--------	0.10			
Cu--------------- Cullison	0-18	10-20	1.20-1.50	2.0-6.0	0.16-0.18	7.4-8.4	<2	Low--------	0.20	5	8	4-8
	18-24	20-40	1.20-1.40	0.6-2.0	0.20-0.22	7.4-8.4	<2	Moderate	0.32			
	24-60	20-40	1.20-1.40	0.6-2.0	0.17-0.19	7.4-8.4	<2	Moderate	0.32			
Cz--------------- Cullison	0-19	15-30	1.20-1.40	0.6-2.0	0.20-0.22	7.4-8.4	<2	Moderate	0.28	5	8	8-16
	19-28	20-40	1.20-1.40	0.6-2.0	0.17-0.19	7.4-8.4	<2	Moderate	0.28			
	28-60	20-40	1.20-1.40	0.6-2.0	0.17-0.19	7.4-8.4	<2	Moderate	0.32			
DfE-------------- Dix	0-4	5-20	1.60-1.80	0.6-2.0	0.12-0.18	6.1-7.8	<2	Low--------	0.17	2	7	1-2
	4-10	2-10	1.70-1.90	6.0-20	0.04-0.06	6.6-8.4	<2	Low--------	0.05			
	10-60	0-3	1.70-2.00	>20	0.02-0.04	6.6-8.4	<2	Low--------	0.05			
DsG*:												
Dix--------------	0-5	5-20	1.60-1.80	0.6-2.0	0.12-0.18	6.1-7.8	<2	Low--------	0.17	2	7	1-2
	5-60	0-3	1.70-2.00	>20	0.02-0.04	6.6-8.4	<2	Low--------	0.05			

See footnote at end of table.

TABLE 17.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permea- bility	Available water capacity	Soil reaction	Salinity	Shrink- swell potential	Erosion factors K	Erosion factors T	Wind erodi- bility group	Organic matter
	In	Pct	g/cc	In/hr	In/in	pH	mmhos/cm					Pct
DsG*:												
Sully-----------	0-6	5-18	1.20-1.40	0.6-2.0	0.20-0.23	6.6-7.8	<2	Low--------	0.43	5	4L	.5-2
	6-60	5-18	1.20-1.40	0.6-2.0	0.16-0.20	7.4-8.4	<2	Low--------	0.43			
Sarben----------	0-6	4-10	1.40-1.55	2.0-6.0	0.10-0.12	6.1-7.3	<2	Low--------	0.17	5	2	.5-1
	6-15	10-18	1.20-1.40	2.0-6.0	0.16-0.18	6.1-7.3	<2	Low--------	0.24			
	15-25	10-18	1.20-1.40	2.0-6.0	0.15-0.17	6.6-7.8	<2	Low--------	0.24			
	25-60	10-18	1.20-1.40	2.0-6.0	0.15-0.17	7.4-8.4	<2	Low--------	0.24			
Dt, DtB---------- Duroc	0-7	15-20	1.20-1.45	0.6-2.0	0.12-0.22	6.6-7.8	<2	Moderate	0.28	5	5	1-3
	7-36	18-27	1.40-1.65	0.6-2.0	0.12-0.20	6.6-7.8	<2	Moderate	0.43			
	36-50	18-27	1.40-1.65	0.6-2.0	0.12-0.20	6.6-7.8	<2	Moderate	0.43			
	50-60	18-27	1.40-1.65	0.6-2.0	0.12-0.20	7.9-9.0	<2	Moderate	0.43			
Du, DuB---------- Duroc	0-6	15-20	1.20-1.45	0.6-2.0	0.14-0.23	6.6-7.8	<2	Moderate	0.32	5	5	1-3
	6-25	18-27	1.40-1.65	0.6-2.0	0.12-0.20	6.6-7.8	<2	Moderate	0.43			
	25-50	18-27	1.40-1.65	0.6-2.0	0.12-0.20	6.6-7.8	<2	Moderate	0.43			
	50-60	18-27	1.40-1.65	0.6-2.0	0.12-0.20	7.9-9.0	<2	Moderate	0.43			
Fu*-------------- Fluvaquents	0-60	1-18	1.30-1.80	6.0-20	0.07-0.13	6.6-8.4	<2	Low--------	0.17	5	8	2-8
Go--------------- Gothenburg	0-3	2-8	1.50-1.60	6.0-20	0.10-0.12	6.6-8.4	<2	Low--------	0.17	2	2	<1
	3-8	1-5	1.50-1.70	6.0-20	0.06-0.08	6.6-8.4	<2	Low--------	0.17			
	8-60	0-2	1.55-1.70	>20	0.02-0.04	6.6-8.4	<2	Low--------	0.10			
IpB-------------- Ipage	0-9	1-5	1.40-1.50	6.0-20	0.07-0.09	5.1-7.3	<2	Low--------	0.15	5	1	.5-1
	9-60	1-8	1.50-1.60	6.0-20	0.04-0.10	5.1-7.3	<2	Low--------	0.15			
Ja--------------- Janise	0-3	10-20	1.20-1.30	0.6-2.0	0.15-0.17	7.9-9.0	<4	Low--------	0.32	5	4L	.5-1
	3-14	10-20	1.20-1.30	0.2-0.6	0.15-0.17	>9.0	<4	Moderate	0.32			
	14-28	10-25	1.20-1.40	0.6-2.0	0.14-0.17	>9.0	<4	Moderate	0.37			
	28-44	10-15	1.30-1.40	0.6-2.0	0.09-0.11	>9.0	<4	Low--------	0.24			
	44-60	2-10	1.40-1.60	>6.0	0.04-0.06	>8.4	<4	Low--------	0.15			
Jd--------------- Janise	0-7	5-15	1.30-1.50	0.6-2.0	0.20-0.24	7.4-9.0	<4	Low--------	0.37	5	4L	.5-2
	7-24	15-28	1.20-1.40	0.2-0.6	0.18-0.22	>8.4	>8	Moderate	0.37			
	24-60	6-18	1.15-1.30	0.6-2.0	0.17-0.22	>8.4	>8	Low--------	0.37			
KeB-------------- Keith	0-11	14-20	1.25-1.45	0.6-2.0	0.20-0.23	6.1-7.3	<2	Low--------	0.28	5	5	1-3
	11-32	18-35	1.10-1.20	0.6-2.0	0.18-0.22	6.6-7.8	<2	Moderate	0.28			
	32-60	8-20	1.30-1.40	0.6-2.0	0.20-0.22	7.4-8.4	<2	Low--------	0.43			
KeC-------------- Keith	0-6	14-20	1.25-1.45	0.6-2.0	0.20-0.23	6.1-7.3	<2	Low--------	0.28	5	5	1-3
	6-26	18-35	1.10-1.20	0.6-2.0	0.18-0.22	6.6-7.8	<2	Moderate	0.28			
	26-60	8-20	1.30-1.40	0.6-2.0	0.20-0.22	7.4-8.4	<2	Low--------	0.43			
Ku, KuB---------- Kuma	0-5	15-27	1.20-1.30	0.6-2.0	0.18-0.21	6.1-8.4	<2	Low--------	0.32	5	5	2-4
	5-36	18-35	1.25-1.35	0.6-2.0	0.18-0.21	6.6-8.4	<2	Moderate	0.37			
	36-60	10-30	1.40-1.50	0.6-2.0	0.16-0.18	7.9-9.0	<2	Low--------	0.32			
La--------------- Lawet	0-10	15-25	1.30-1.50	0.6-2.0	0.20-0.24	7.4-8.4	<2	Low--------	0.28	5	4L	3-6
	10-60	22-35	1.30-1.50	0.2-2.0	0.14-0.19	7.4-9.0	<2	Moderate	0.28			
Le--------------- Lex	0-11	15-27	1.40-1.60	0.6-2.0	0.20-0.24	7.4-8.4	<2	Low--------	0.28	4	4L	1-3
	11-24	7-32	1.30-1.70	0.2-6.0	0.15-0.22	6.1-8.4	<2	Low--------	0.28			
	24-60	2-5	1.50-1.70	>20	0.02-0.06	6.1-7.8	<2	Low--------	0.10			
Lp--------------- Lodgepole	0-7	16-25	1.20-1.40	0.6-2.0	0.22-0.24	6.1-7.8	<2	Low--------	0.37	3	6	1-3
	7-60	35-50	1.25-1.40	<0.06	0.13-0.18	6.1-7.8	<2	High-------	0.28			

See footnote at end of table.

TABLE 17.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permea- bility	Available water capacity	Soil reaction	Salinity	Shrink- swell potential	Erosion factors K	Erosion factors T	Wind erodi- bility group	Organic matter
	In	Pct	g/cc	In/hr	In/in	pH	mmhos/cm					Pct
Ma----------------- Marlake	0-8	5-15	1.40-1.50	2.0-6.0	0.16-0.18	6.6-8.4	<2	Low--------	0.20	2	8	4-8
	8-60	0-5	1.50-1.60	6.0-20	0.05-0.07	6.6-8.4	<2	Low--------	0.17			
Me----------------- Merrick	0-25	18-27	1.30-1.50	0.6-2.0	0.20-0.22	6.6-7.8	<2	Low--------	0.24	5	6	2-4
	25-42	27-35	1.30-1.50	0.6-2.0	0.17-0.19	7.4-7.8	<2	Low--------	0.32			
	42-60	18-30	1.30-1.50	0.6-2.0	0.16-0.19	7.4-8.4	<2	Low--------	0.32			
No----------------- Norwest	0-15	18-27	1.30-1.40	0.6-2.0	0.20-0.22	7.4-8.4	<2	Moderate	0.28	5	4L	2-4
	15-34	18-35	1.30-1.40	0.6-2.0	0.17-0.19	7.4-8.4	<2	Moderate	0.32			
	34-60	5-25	1.25-1.50	0.6-6.0	0.11-0.19	7.4-8.4	<2	Low--------	0.24			
Pp*---------------- Pits and dumps	0-60	0-8	1.70-2.00	>6.0	0.02-0.09	6.6-8.4	<2	Low--------	0.10	2	8	<.5
Pt----------------- Platte	0-5	10-20	1.50-1.70	0.6-2.0	0.20-0.24	6.6-8.4	<2	Low--------	0.28	3	4L	1-3
	5-18	7-18	1.70-1.90	0.6-2.0	0.15-0.19	6.6-8.4	<2	Low--------	0.28			
	18-60	0-3	1.90-2.00	>20	0.02-0.04	6.6-8.4	<2	Low--------	0.10			
RtB, RtD---------- Rosebud	0-6	8-20	1.20-1.45	0.6-2.0	0.22-0.24	6.6-8.4	<2	Low--------	0.28	4	5	2-4
	6-21	23-35	1.15-1.30	0.6-2.0	0.15-0.17	6.6-8.4	<2	Moderate	0.28			
	21-30	15-26	1.30-1.50	0.6-2.0	0.11-0.17	7.4-9.0	<2	Low--------	0.28			
	30-60	---	---	0.2-0.6	---	---	---	-----------	----			
SaB, SaC, SaD, SaE-------------- Sarben	0-5	4-10	1.40-1.55	2.0-6.0	0.10-0.12	6.1-7.3	<2	Low--------	0.17	5	2	.5-1
	5-11	10-18	1.20-1.40	2.0-6.0	0.16-0.18	6.1-7.3	<2	Low--------	0.24			
	11-35	10-18	1.20-1.40	2.0-6.0	0.15-0.17	6.6-7.8	<2	Low--------	0.24			
	35-60	10-18	1.20-1.40	2.0-6.0	0.15-0.17	7.4-8.4	<2	Low--------	0.24			
Sb----------------- Satanta	0-6	10-25	1.30-1.40	0.6-2.0	0.20-0.22	6.1-7.8	<2	Low--------	0.28	5	6	1-2
	6-34	18-35	1.35-1.45	0.6-2.0	0.16-0.19	6.6-8.4	<2	Moderate	0.28			
	34-60	5-15	1.30-1.40	0.6-2.0	0.12-0.18	7.4-8.4	<2	Low--------	0.32			
SbB, SbC---------- Satanta	0-6	10-25	1.30-1.40	0.6-2.0	0.20-0.22	6.1-7.8	<2	Low--------	0.28	5	6	1-2
	6-60	18-35	1.35-1.45	0.6-2.0	0.16-0.19	6.6-8.4	<2	Moderate	0.28			
ScD*:												
Satanta----------	0-6	10-25	1.30-1.40	0.6-2.0	0.20-0.22	6.1-7.8	<2	Low--------	0.28	5	6	1-2
	6-29	18-35	1.35-1.45	0.6-2.0	0.16-0.19	6.6-8.4	<2	Moderate	0.28			
	29-60	5-15	1.30-1.40	0.6-2.0	0.12-0.18	7.4-8.4	<2	Low--------	0.32			
Dix--------------	0-4	5-20	1.60-1.80	0.6-2.0	0.12-0.18	6.1-7.8	<2	Low--------	0.17	2	7	1-2
	4-60	0-3	1.70-2.00	>20	0.02-0.04	6.6-8.4	<2	Low--------	0.05			
SfD---------------- Sully	0-5	7-20	1.25-1.45	0.6-2.0	0.20-0.22	6.6-7.8	<2	-----------	0.37	5	4L	.5-2
	5-60	5-18	1.20-1.40	0.6-2.0	0.16-0.20	7.4-8.4	<2	Low--------	0.43			
SfG---------------- Sully	0-6	7-20	1.25-1.45	0.6-2.0	0.20-0.22	6.6-7.8	<2	-----------	0.37	5	4L	.5-2
	6-60	5-18	1.20-1.40	0.6-2.0	0.16-0.20	7.4-8.4	<2	Low--------	0.43			
SkE*:												
Sully------------	0-6	7-20	1.25-1.45	0.6-2.0	0.20-0.22	6.6-7.8	<2	-----------	0.37	5	4L	.5-2
	6-60	5-18	1.20-1.40	0.6-2.0	0.16-0.20	7.4-8.4	<2	Low--------	0.43			
Dix--------------	0-4	5-20	1.60-1.80	0.6-2.0	0.12-0.18	6.1-7.8	<2	Low--------	0.17	2	7	1-2
	4-60	0-3	1.70-2.00	>20	0.02-0.04	6.6-8.4	<2	Low--------	0.05			
SmE2*:												
Sully------------	0-5	7-20	1.25-1.45	0.6-2.0	0.20-0.22	6.6-7.8	<2	-----------	0.37	5	4L	.5-2
	5-60	5-18	1.20-1.40	0.6-2.0	0.16-0.20	7.4-8.4	<2	Low--------	0.43			

See footnote at end of table.

TABLE 17.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permea- bility	Available water capacity	Soil reaction	Salinity	Shrink- swell potential	Erosion factors K	Erosion factors T	Wind erodi- bility group	Organic matter
	In	Pct	g/cc	In/hr	In/in	pH	mmhos/cm					Pct
SmE2*:												
McConaughy------	0-6	7-18	1.20-1.40	0.6-2.0	0.20-0.23	6.6-7.8	<2	Low--------	0.28	5	5	1-3
	6-21	10-18	1.20-1.40	0.6-2.0	0.16-0.20	7.4-8.4	<2	Low--------	0.43			
	21-60	5-18	1.20-1.40	0.6-2.0	0.16-0.20	7.9-9.0	<2	Low--------	0.43			
SmF*:												
Sully-----------	0-3	7-20	1.25-1.45	0.6-2.0	0.20-0.22	6.6-7.8	<2	-----------	0.37	5	4L	.5-2
	3-60	5-18	1.20-1.40	0.6-2.0	0.16-0.20	7.4-8.4	<2	Low--------	0.43			
McConaughy------	0-13	7-18	1.20-1.40	0.6-2.0	0.20-0.23	6.6-7.8	<2	Low--------	0.28	5	5	1-3
	13-34	10-18	1.20-1.40	0.6-2.0	0.16-0.20	7.4-8.4	<2	Low--------	0.43			
	34-60	5-18	1.20-1.40	0.6-2.0	0.16-0.20	7.9-9.0	<2	Low--------	0.43			
TaG*:												
Tassel----------	0-7	5-12	1.20-1.45	2.0-6.0	0.12-0.18	7.4-8.4	<2	Low--------	0.37	2	3	.5-3
	7-15	5-12	1.40-1.70	2.0-6.0	0.12-0.18	7.4-8.4	<2	Low--------	0.24			
	15-60	---	---	0.2-0.6	---	---	---	-----------	----			
Otero-----------	0-8	5-18	1.40-1.60	2.0-6.0	0.18-0.22	7.4-8.4	<2	Low--------	0.37	5	3	.5-1
	8-60	5-10	1.45-1.75	2.0-6.0	0.12-0.19	7.4-8.4	<2	Low--------	0.32			
Rock outcrop----	0-60	---	---	---	---	---	<2	-----------	----	---	---	---
VdB, VdD, VdE---- Valent	0-6	2-6	1.55-1.65	6.0-20	0.05-0.10	6.6-7.8	<2	Low--------	0.15	5	1	.5-1
	6-60	2-8	1.60-1.70	6.0-20	0.05-0.10	6.6-7.8	<2	Low--------	0.15			
VdF*:												
Valent----------	0-4	2-6	1.55-1.65	6.0-20	0.05-0.10	6.6-7.8	<2	Low--------	0.15	5	1	.5-1
	4-60	2-8	1.60-1.70	6.0-20	0.05-0.10	6.6-7.8	<2	Low--------	0.15			
Valent----------	0-4	2-6	1.55-1.65	6.0-20	0.05-0.10	6.6-7.8	<2	Low--------	0.15	5	1	.5-1
	4-60	2-8	1.60-1.70	6.0-20	0.05-0.10	6.6-7.8	<2	Low--------	0.15			
VgG-------------- Valent	0-3	2-6	1.55-1.65	6.0-20	0.05-0.10	6.6-7.8	<2	Low--------	0.15	5	1	.5-1
	3-60	2-8	1.60-1.70	6.0-20	0.05-0.10	6.6-7.8	<2	Low--------	0.15			
VtG*:												
Valent----------	0-5	2-6	1.55-1.65	6.0-20	0.05-0.10	6.6-7.8	<2	Low--------	0.15	5	1	.5-1
	5-60	2-8	1.60-1.70	6.0-20	0.05-0.10	6.6-7.8	<2	Low--------	0.15			
Tassel----------	0-8	5-12	1.30-1.50	2.0-6.0	0.12-0.16	7.4-8.4	<2	Low--------	0.24	2	3	.5-3
	8-12	5-12	1.40-1.70	2.0-6.0	0.12-0.18	7.4-8.4	<2	Low--------	0.24			
Rock outcrop----	0-60	---	---	---	---	---	<2	-----------	----	---	---	---
VwB-------------- Vetal	0-8	5-10	1.25-1.35	2.0-6.0	0.10-0.12	6.6-7.8	<2	Low--------	0.20	5	2	1-3
	8-38	12-18	1.25-1.35	2.0-6.0	0.11-0.19	6.6-7.8	<2	Low--------	0.20			
	38-60	5-10	1.40-1.50	6.0-20	0.08-0.10	7.4-8.4	<2	Low--------	0.20			
Wa--------------- Wann	0-14	5-15	1.40-1.60	2.0-6.0	0.13-0.18	6.6-8.4	<2	Low--------	0.20	5	3	1-3
	14-51	3-18	1.40-1.65	2.0-6.0	0.11-0.17	7.4-8.4	<2	Low--------	0.20			
	51-60	3-22	1.40-1.60	2.0-6.0	0.09-0.12	7.4-8.4	<2	Low--------	0.15			

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 18.--SOIL AND WATER FEATURES

("Flooding" and "water table" and terms such as "rare," "brief," "apparent," and "perched" are explained in the text. The symbol < means less than; > means more than. Absence of an entry indicates that the feature is not a concern or that data were not estimated)

Soil name and map symbol	Hydrologic group	Flooding: Frequency	Flooding: Duration	Flooding: Months	High water table: Depth	High water table: Kind	High water table: Months	Bedrock: Depth	Bedrock: Hardness	Potential frost action	Risk of corrosion: Uncoated steel	Risk of corrosion: Concrete
					Ft			In				
Ad----------------- Alda	C	Occasional	Brief-----	Apr-Jul	2.0-3.0	Apparent	Nov-May	>60	---	High-----	Moderate	Low.
AwF*:												
Altvan------------	B	None--------	---	---	>6.0	---	---	>60	---	Moderate	Low------	Low.
Dix---------------	A	None--------	---	---	>6.0	---	---	>60	---	Low------	Low------	Low.
Bb, Bc------------ Bankard	A	Rare--------	---	---	>6.0	---	---	>60	---	Low------	Moderate	Low.
Bd---------------- Bankard	A	Frequent----	Brief-----	Mar-Jun	>6.0	---	---	>60	---	Low------	High-----	Low.
BeB--------------- Bayard	B	None--------	---	---	>6.0	---	---	>60	---	Moderate	Low------	Low.
Bo---------------- Boel	A	Rare--------	---	---	1.5-3.5	Apparent	Nov-May	>60	---	Moderate	High-----	Low.
Bs, BtB----------- Bridget	B	None--------	---	---	>6.0	---	---	>60	---	Moderate	Low------	Low.
ChB--------------- Chappell	A	None--------	---	---	>6.0	---	---	>60	---	Low------	Low------	Low.
Cu---------------- Cullison	D	Rare--------	---	---	0-1.5	Apparent	Nov-May	>60	---	Moderate	High-----	Low.
Cz---------------- Cullison	D	None--------	---	---	+.5-1.0	Apparent	Nov-May	>60	---	Moderate	High-----	Low.
DfE--------------- Dix	A	None--------	---	---	>6.0	---	---	>60	---	Low------	Low------	Low.
DsG*:												
Dix---------------	A	None--------	---	---	>6.0	---	---	>60	---	Low------	Low------	Low.
Sully-------------	B	None--------	---	---	>6.0	---	---	>60	---	Low------	High-----	Low.
Sarben------------	B	None--------	---	---	>6.0	---	---	>60	---	Low------	High-----	Low.

See footnote at end of table.

TABLE 18.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydro-logic group	Flooding: Frequency	Flooding: Duration	Flooding: Months	High water table: Depth	High water table: Kind	High water table: Months	Bedrock: Depth	Bedrock: Hardness	Potential frost action	Risk of corrosion: Uncoated steel	Risk of corrosion: Concrete
					Ft			In				
Dt, DtB, Du, DuB--Duroc	B	None--------	---	---	>6.0	---	---	>60	---	Low------	Low------	Low.
Fu*---------------Fluvaquents	D	Frequent----	Brief to very long.	Nov-Jun	+2-1.0	Apparent	Jan-Dec	>60	---	Moderate	High-----	Low.
Go----------------Gothenburg	D	Occasional	Brief-----	Mar-Jun	0-2.0	Apparent	Nov-Jun	>60	---	Moderate	Moderate	Low.
IpB---------------Ipage	A	None--------	---	---	3.0-6.0	Apparent	Dec-Jun	>60	---	Moderate	Low------	Moderate.
Ja----------------Janise	C	Occasional	Brief-----	Feb-Jun	2.0-3.0	Apparent	Dec-Jul	>60	---	High-----	High-----	High.
Jd----------------Janise	C	Rare--------	---	---	>6.0	---	---	>60	---	Moderate	High-----	High.
KeB, KeC----------Keith	B	None--------	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Low.
Ku, KuB-----------Kuma	B	None--------	---	---	>6.0	---	---	>60	---	Moderate	High-----	Moderate.
La----------------Lawet	B/D	Rare--------	---	---	1.0-2.0	Apparent	May-Nov	>60	---	High-----	High-----	Moderate.
Le----------------Lex	B	Rare--------	---	---	1.5-3.0	Apparent	Nov-May	>60	---	High-----	High-----	Low.
Lp----------------Lodgepole	D	None--------	---	---	+.5-1.0	Perched	Apr-Jun	>60	---	High-----	High-----	Low.
Ma----------------Marlake	D	None--------	---	---	+2-1.0	Apparent	Oct-Jun	>60	--	Moderate	High-----	Low.
Me----------------Merrick	B	Rare--------	---	---	4.0-6.0	Apparent	Nov-May	>60	---	Moderate	Low------	Low.
No----------------Norwest	B	Rare--------	---	---	1.5-3.0	Apparent	Nov-Jun	>60	---	High-----	High-----	Moderate.
Pp*---------------Pits and dumps	A	Rare--------	---	---	>6.0	---	---	>60	---	Low------	Low------	Low.

See footnote at end of table.

TABLE 18.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
Pt----------------- Platte	B	Occasional	Brief-----	Mar-Oct	1.0-2.0	Apparent	Feb-Jun	>60	---	Moderate	High-----	Moderate.
RtB, RtD---------- Rosebud	B	None--------	---	---	>6.0	---	---	20-40	Soft	Moderate	High-----	Low.
SaB, SaC, SaD, SaE-------------- Sarben	B	None--------	---	---	>6.0	---	---	>60	---	Low------	High-----	Low.
Sb, SbB, SbC------ Satanta	B	None--------	---	---	>6.0	---	---	>60	---	Moderate	Low------	Low.
ScD*:												
Satanta----------	B	None--------	---	---	>6.0	---	---	>60	---	Moderate	Low------	Low.
Dix--------------	A	None--------	---	---	>6.0	---	---	>60	---	Low------	Low------	Low.
SfD, SfG---------- Sully	B	None--------	---	---	>6.0	---	---	>60	---	Low------	High-----	Low.
SkE*:												
Sully------------	B	None--------	---	---	>6.0	---	---	>60	---	Low-----	High-----	Low.
SkE*:												
Dix--------------	A	None--------	---	---	>6.0	---	---	>60	---	Low------	Low------	Low.
SmE2*, SmF*:												
Sully------------	B	None--------	---	---	>6.0	---	---	>60	---	Low------	High-----	Low.
McConaughy-------	B	None--------	---	---	>6.0	---	---	>60	---	Moderate	High-----	Moderate.
TaG*:												
Tassel-----------	D	None--------	---	---	>6.0	---	---	6-20	Soft	Low------	Low------	Low.
Otero------------	B	None--------	---	---	>6.0	---	---	>60	---	Low------	High-----	Low.
Rock outcrop-----	D	None--------	---	---	>6.0	---	---	0	Soft	---	---	---
VdB, VdD, VdE----- Valent	A	None--------	---	---	>6.0	---	---	>60	---	Low------	Moderate	Low.
VdF*:												
Valent-----------	A	None--------	---	---	>6.0	---	---	>60	---	Low------	Moderate	Low.
Valent-----------	A	None--- ----	---	---	>6.0	---	---	>60	---	Low------	Moderate	Low.

See footnote at end of table.

TABLE 18.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydro-logic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
VgG---------------- Valent	A	None---------	---	---	>6.0	---	---	>60	---	Low------	Moderate	Low.
VtG*:												
Valent------------	A	None---------	---	---	>6.0	---	---	>60	---	Low------	Moderate	Low.
Tassel------------	D	None---------	---	---	>6.0	---	---	6-20	Soft	Low------	Low------	Low.
Rock outcrop-----	D	None---------	---	---	>6.0	---	---	0	Soft	---	---	---
VwB---------------- Vetal	B	None---------	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Low.
Wa----------------- Wann	B	Rare---------	---	---	1.5-3.5	Apparent	Mar-Jul	>60	---	High-----	Moderate	Low.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 19.--ENGINEERING INDEX TEST DATA

(Dashes indicate that data were not available. LL means liquid limit; PI, plasticity index; and NP, nonplastic)

Soil name*, report number, horizon, and depth in inches	Classification		Grain-size distribution									LL	PI	Specific gravity
			Percentage passing sieve--						Percentage smaller than--					
	AASHTO	Unified	3/4 inch	3/8 inch	No. 4	No. 10	No. 40	No. 200	.05 mm	.005 mm	.002 mm	Pct		
Dix gravelly loam: (S87NE-101-3)														
A------ 0 to 5	A-1-b(4)	SP-SM	96	83	71	52	27	9	8	---	3	NP	NP	2.61
C------ 5 to 60	A-1-a(4)	SP	96	87	73	50	16	2	2	---	2	NP	NP	2.60
Duroc silt loam: (S87NE-101-5)														
Ap----- 0 to 6	A-4(8)	ML	---	---	---	---	100	88	73	---	17	28	4	2.59
A1----- 6 to 25	A-6(10)	CL	---	---	---	---	---	94	81	---	21	36	15	2.60
AC----- 34 to 50	A-6(9)	CL	---	---	---	---	---	90	78	---	19	33	12	2.62
Keith loam: (S86NE-101-39)														
Ap----- 0 to 6	A-4(8)	ML	---	---	---	---	---	88	74	---	17	28	7	2.59
Bt1---- 6 to 16	A-7-6(13)	CL	---	---	---	---	---	89	77	---	28	41	23	2.61
C2----- 42 to 60	A-4(8)	ML	---	---	---	---	---	89	73	---	8	25	2	2.63
Kuma loam: (S85NE-101-20)														
Ap----- 0 to 5	A-4(8)	ML	---	---	---	---	---	91	76	---	16	28	5	2.62
Bt2---- 8 to 12	A-6(9)	CL	---	---	---	---	---	94	83	---	24	34	13	2.63
Btb1--- 12 to 19	A-6(10)	CL	---	---	---	---	---	92	79	---	27	36	16	2.69
C1----- 36 to 49	A-4(8)	ML	---	---	---	---	---	90	75	---	14	27	2	2.71
C2----- 49 to 67	A-4(8)	ML	---	---	---	---	---	91	73	---	11	25	1	2.67
Sarben loamy fine sand: (S86NE-101-40)														
Ap----- 0 to 8	A-2-4(0)	SM	---	---	---	---	98	25	13	---	5	NP	NP	2.62
C1----- 12 to 32	A-2-4(0)	SM	---	---	---	---	99	31	16	---	7	NP	NP	2.62
Satanta loam: (S85NE-101-21)														
Ap----- 0 to 6	A-4(5)	ML	---	---	100	99	88	60	45	---	8	21	NP	2.63
Bt1---- 6 to 15	A-6(8)	CL	---	---	---	100	93	72	60	---	19	30	12	2.64
C------ 34 to 60	A-2-4(-1)	SM	---	---	---	100	72	25	16	---	4	NP	NP	2.69
Sully loam: (S86NE-101-37)														
A------ 0 to 5	A-4(8)	ML	---	---	---	---	---	84	54	---	11	28	4	2.60
C2----- 30 to 60	A-4(8)	ML	---	---	---	---	---	90	72	---	7	26	3	2.62

See footnote at end of table.

TABLE 19.--ENGINEERING INDEX TEST DATA--Continued

Soil name*, report number, horizon, and depth in inches	Classification		Grain-size distribution									LL	PI	Specific gravity
			Percentage passing sieve--						Percentage smaller than--					
	AASHTO	Unified	3/4 inch	3/8 inch	No. 4	No. 10	No. 40	No. 200	.05 mm	.005 mm	.002 mm	Pct		
Valent fine sand: (S85NE-101-18)														
A------ 0 to 6	A-3(-2)	SP-SM	---	---	---	---	99	7	6	---	3	NP	NP	2.64
AC----- 6 to 13	A-3(-2)	SP-SM	---	---	---	---	99	6	5	---	5	NP	NP	2.67
C------ 13 to 60	A-3(-2)	SP-SM	---	---	---	---	99	9	7	---	3	NP	NP	2.63

* Locations of the sampled pedons are as follows:

Dix gravelly loam: 250 feet south and 1,650 feet east of the northwest corner of sec. 21, T. 31 N., R. 41 W.

Duroc silt loam: 1,025 feet south and 2,275 feet west of the northeast corner of sec. 13, T. 14 N., R. 40 W.

Keith loam: 200 feet east and 550 feet north of the southwest corner of sec. 19, T. 14 N., R. 39 W.

Kuma loam: 2,300 feet east and 1,700 feet north of the southwest corner of sec. 29, T. 14 N., R. 40 W.

Sarben loamy fine sand: 400 feet west and 450 feet north of the southeast corner of sec. 13, T. 14 N., R. 39 W.

Satanta loam: 150 feet east and 350 feet south of the northeast corner of sec. 36, T. 13 N., R. 39 W.

Sully loam: 1,750 feet west and 2,100 feet south of the northeast corner of sec. 12, T. 14 N., R. 40 W.

Valent fine sand: 2,100 feet east and 700 feet north of the southwest corner of sec. 7, T. 16 N., R. 38 W.

TABLE 20.--CLASSIFICATION OF THE SOILS

(An asterisk in the first column indicates that the soil is a taxadjunct to the series. See text for a description of those characteristics of the soil that are outside the range of the series)

Soil name	Family or higher taxonomic class
Alda	Coarse-loamy, mixed, mesic Fluvaquentic Haplustolls
Altvan	Fine-loamy over sandy or sandy-skeletal, mixed, mesic Aridic Argiustolls
Bankard	Sandy, mixed, mesic Ustic Torrifluvents
Bayard	Coarse-loamy, mixed, mesic Torriorthentic Haplustolls
Boel	Sandy, mixed, mesic Fluvaquentic Haplustolls
Bridget	Coarse-silty, mixed, mesic Torriorthentic Haplustolls
Chappell	Coarse-loamy, mixed, mesic Aridic Haplustolls
Cullison	Coarse-loamy, mesic Typic Calciaquolls
*Dix	Sandy-skeletal, mixed, mesic Torriorthentic Haplustolls
Duroc	Fine-silty, mixed, mesic Pachic Haplustolls
Fluvaquents	Fluvaquents
Gothenburg	Mixed, mesic Typic Psammaquents
Ipage	Mixed, mesic Aquic Ustipsamments
*Janise	Coarse-silty, mixed (calcareous), mesic Typic Halaquepts
Keith	Fine-silty, mixed, mesic Aridic Argiustolls
Kuma	Fine-silty, mixed, mesic Pachic Argiustolls
Lawet	Fine-loamy, mesic Typic Calciaquolls
Lex	Fine-loamy over sandy or sandy-skeletal, mixed (calcareous), mesic Fluvaquentic Haplaquolls
Lodgepole	Fine, montmorillonitic, mesic Typic Argiaquolls
Marlake	Sandy, mixed, mesic Mollic Fluvaquents
McConaughy	Coarse-silty, mixed, mesic Aridic Haplustolls
Merrick	Fine-loamy, mixed, mesic Cumulic Haplustolls
Norwest	Fine-loamy, mesic Aeric Calciaquolls
*Otero	Coarse-loamy, mixed (calcareous), mesic Ustic Torriorthents
Platte	Sandy, mixed, mesic Mollic Fluvaquents
Rosebud	Fine-loamy, mixed, mesic Aridic Argiustolls
Sarben	Coarse-loamy, mixed, nonacid, mesic Aridic Ustorthents
Satanta	Fine-loamy, mixed, mesic Aridic Argiustolls
Sully	Coarse-silty, mixed (calcareous), mesic Typic Ustorthents
Tassel	Loamy, mixed (calcareous), mesic, shallow Ustic Torriorthents
Valent	Mixed, mesic Ustic Torripsamments
Vetal	Coarse-loamy, mixed, mesic Pachic Haplustolls
Wann	Coarse-loamy, mixed, mesic Fluvaquentic Haplustolls

Interpretive Groups

INTERPRETIVE GROUPS

(Dashes indicate that the soil was not assigned to the interpretive group. N means nonirrigated and I, irrigated)

Map symbol and soil name	Land capability N	Land capability I	Prime farmland	Range site	Windbreak suitability group
Ad---------------------------- Alda	IIIw-6	IIIw-9	---	Subirrigated	2S
AwF----------------------------	VIe-3	---	---		
Altvan----------------------				Silty	10
Dix--------------------------				Shallow to Gravel	10
Bb---------------------------- Bankard	VIs-3	---	---	Shallow to Gravel	10
Bc---------------------------- Bankard	IVe-5	IVe-11	---	Sandy Lowland	7
Bd---------------------------- Bankard	VIw-7	---	---	Shallow to Gravel	10
BeB--------------------------- Bayard	IIe-3	IIe-8	Yes*	Sandy	5
Bo---------------------------- Boel	IVw-5	IVw-11	---	Subirrigated	2S
Bs---------------------------- Bridget	IIc-1	I-6	Yes*	Silty	3
BtB--------------------------- Bridget	IIe-1	IIe-6	Yes*	Silty	3
ChB--------------------------- Chappell	IIIe-3	IIIe-9	Yes*	Sandy	6G
Cu---------------------------- Cullison	Vw-7	---	---	Wet Subirrigated	2D
Cz---------------------------- Cullison	Vw-7	---	---	Wet Land	10
DfE--------------------------- Dix	VIs-4	---	---	Shallow to Gravel	10
DsG---------------------------	VIIs-4	---	---		
Dix--------------------------				Shallow to Gravel	10
Sully------------------------				Thin Loess	10
Sarben-----------------------				Sandy	10
Dt---------------------------- Duroc	IIc-1	I-6	Yes*	Silty	3
DtB--------------------------- Duroc	IIe-1	IIe-6	Yes*	Silty	3
Du---------------------------- Duroc	IIc-1	I-6	Yes*	Silty	3
DuB--------------------------- Duroc	IIe-1	IIe-6	Yes*	Silty	3

See footnotes at end of table.

INTERPRETIVE GROUPS--Continued

Map symbol and soil name	Land capability N	Land capability I	Prime farmland	Range site	Windbreak suitability group
Fu--------------------------- Fluvaquents	VIIIw-7	---	---	---	10
Go--------------------------- Gothenburg	VIIs-3	---	---	---	10
IpB-------------------------- Ipage	VIe-5	IVe-12	---	Sandy Lowland	7
Ja--------------------------- Janise	VIs-1	---	---	Saline Subirrigated	10
Jd--------------------------- Janise	VIs-1	IVs-6	---	Saline Lowland	10
KeB-------------------------- Keith	IIe-1	IIe-4	Yes*	Silty	3
KeC-------------------------- Keith	IIIe-1	IIIe-4	Yes*	Silty	3
Ku--------------------------- Kuma	IIc-1	I-4	Yes*	Silty	3
KuB-------------------------- Kuma	IIe-1	IIe-4	Yes*	Silty	3
La--------------------------- Lawet	Vw-7	---	---	Wet Subirrigated	2D
Le--------------------------- Lex	IIIw-4	IIIw-7	Yes**	Subirrigated	2S
Lp--------------------------- Lodgepole	IIIw-2	IVw-2	---	Clayey Overflow	2W
Ma--------------------------- Marlake	VIIIw-7	---	---	---	10
Me--------------------------- Merrick	IIc-1	I-6	Yes*	Silty Lowland	1
No--------------------------- Norwest	IIIw-4	IIIw-6	Yes**	Subirrigated	2S
Pp--------------------------- Pits-dumps	VIIIs-8	---	---	---	10
Pt--------------------------- Platte	VIw-4	IVw-13	---	Subirrigated	2S
RtB-------------------------- Rosebud	IIIe-1	IIIe-4	Yes*	Silty	6R
RtD-------------------------- Rosebud	IVe-1	IVe-4	---	Silty	6R
SaB-------------------------- Sarben	IVe-5	IIIe-10	---	Sandy	5

See footnotes at end of table.

INTERPRETIVE GROUPS--Continued

Map symbol and soil name	Land capability N	Land capability I	Prime farmland	Range site	Windbreak suitability group
SaC: Sarben	IVe-5	IVe-10	---	Sandy	5
SaD: Sarben	VIe-5	IVe-10	---	Sandy	5
SaE: Sarben	VIe-5	---	---	Sandy	7
Sb: Satanta	IIc-1	I-4	Yes*	Silty	3
SbB: Satanta	IIe-1	IIe-4	Yes*	Silty	3
SbC: Satanta	IIIe-1	IIIe-4	Yes*	Silty	3
ScD	IVe-1	IVe-4	---		
Satanta				Silty	3
Dix				Shallow to Gravel	10
SfD: Sully	IVe-9	IVe-6	---	Limy Upland	8
SfG: Sully	VIIe-9	---	---	Thin Loess	10
SkE	VIe-9	---	---		
Sully				Limy Upland	8
Dix				Shallow to Gravel	10
SmE2	VIe-9	---	---		
Sully				Limy Upland	8
McConaughy				Silty	3
SmF	VIe-9	---	---		
Sully				Limy Upland	10
McConaughy				Silty	10
TaG	VIIs-4	---	---		
Tassel				Shallow Limy	10
Otero				Limy Upland	10
Rock outcrop				---	10
VdB: Valent	VIe-5	IVe-12	---	Sandy	7
VdD: Valent	VIe-5	IVe-12	---	Sands	7
VdE: Valent	VIe-5	---	---	Sands	7
VdF	VIIe-5	---	---		
Valent				Sands	10
Valent				Choppy Sands	10
VgG: Valent	VIIe-5	---	---	Choppy Sands	10

See footnotes at end of table.

INTERPRETIVE GROUPS--Continued

Map symbol and soil name	Land capability N	Land capability I	Prime farmland	Range site	Windbreak suitability group
VtG	VIIs-4	---	---		
Valent				Sands	10
Tassel				Shallow Limy	10
Rock outcrop				---	10
VwB	IIIe-5	IIIe-10	---	Sandy	5
Vetal					
Wa	IIw-6	IIw-8	Yes	Subirrigated	2S
Wann					

* Where irrigated.
** Where drained.

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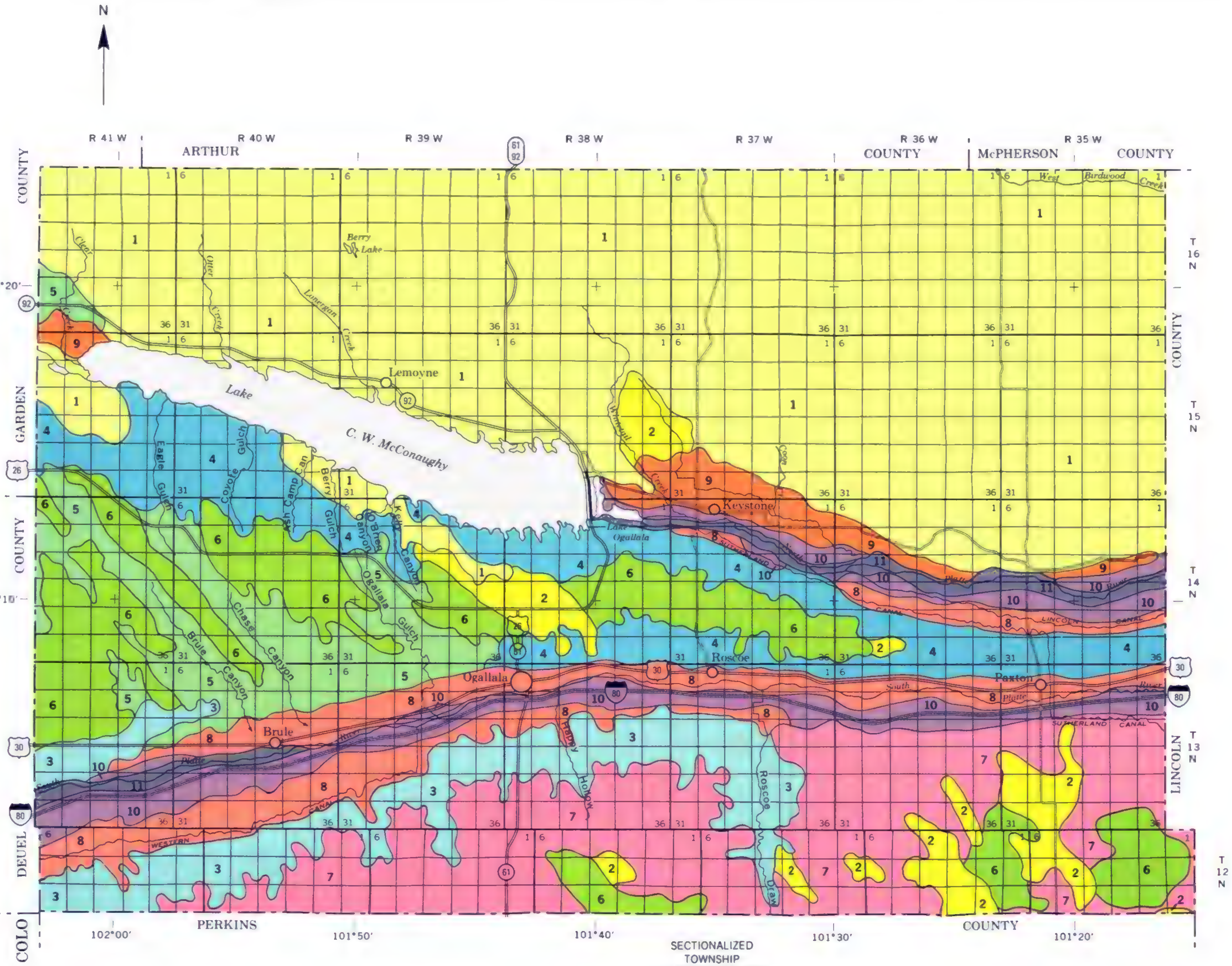


SOIL LEGEND*

1 Valent association
2 Sarben-Vetal association
3 Satanta-Dix-Altvan association
4 Sully-Dix-Tassel association
5 Sully-McConaughy association
6 Kuma-Duroc-Keith association
7 Satanta-Kuma association
8 Bayard-Duroc-Bridget association
9 Janise-Boel-Lawet association
10 Lex-Norwest-Alda association
11 Gothenburg-Platte association

* The units on this legend are described in the text under the heading "General Soil Map Units."

Compiled 1994

UNITED STATES DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE
UNIVERSITY OF NEBRASKA
CONSERVATION AND SURVEY DIVISION

GENERAL SOIL MAP

KEITH COUNTY, NEBRASKA

Scale 1:253,440

1 0 1 2 3 4 Mi

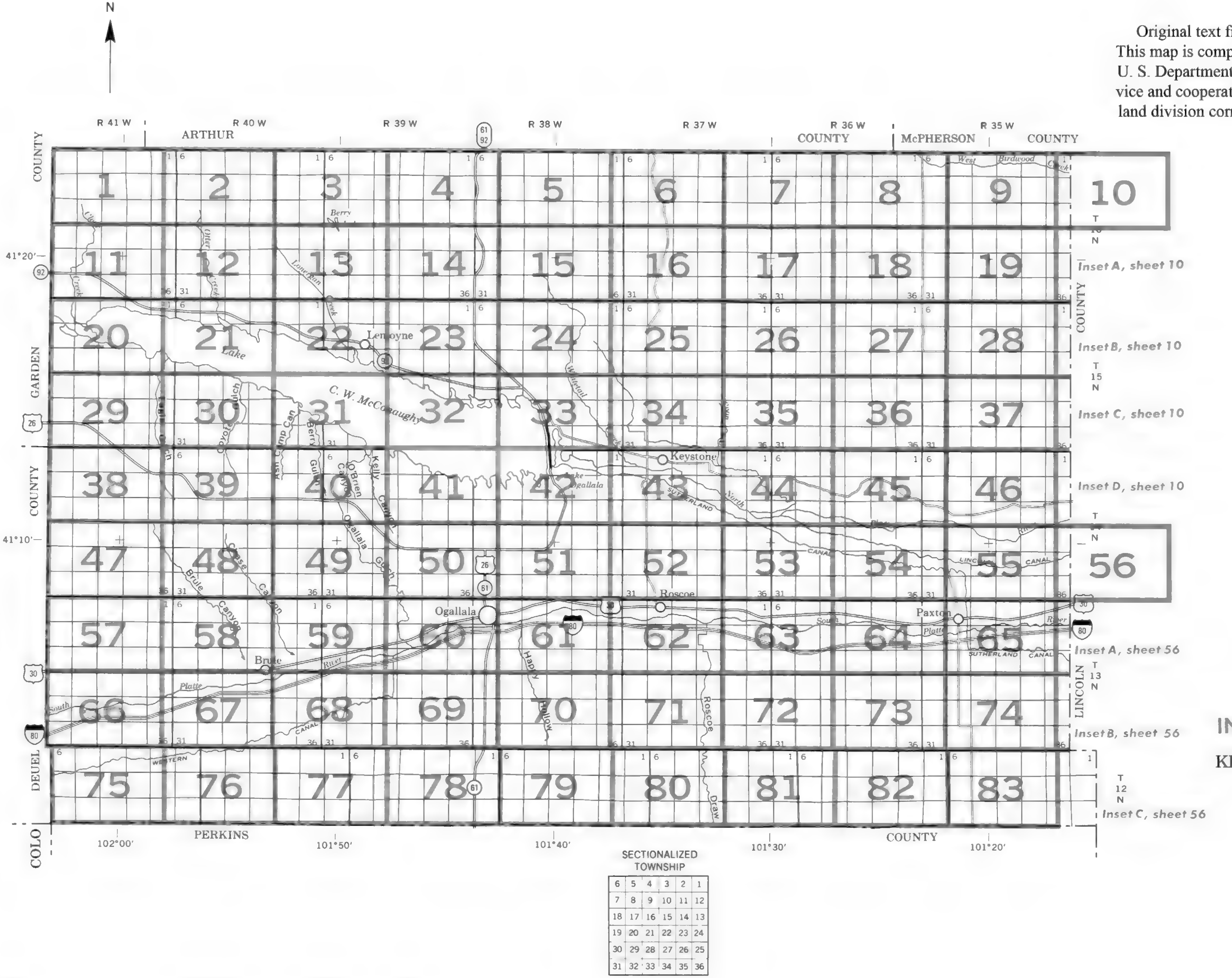
1 0 4 8 Km

SECTIONALIZED TOWNSHIP

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

Each area outlined on this map consists of more than one kind of soil. The map is thus meant for general planning rather than a basis for decisions on the use of specific tracts.

Original text from each individual map sheet read: This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



INDEX TO MAP SHEETS

KEITH COUNTY, NEBRASKA

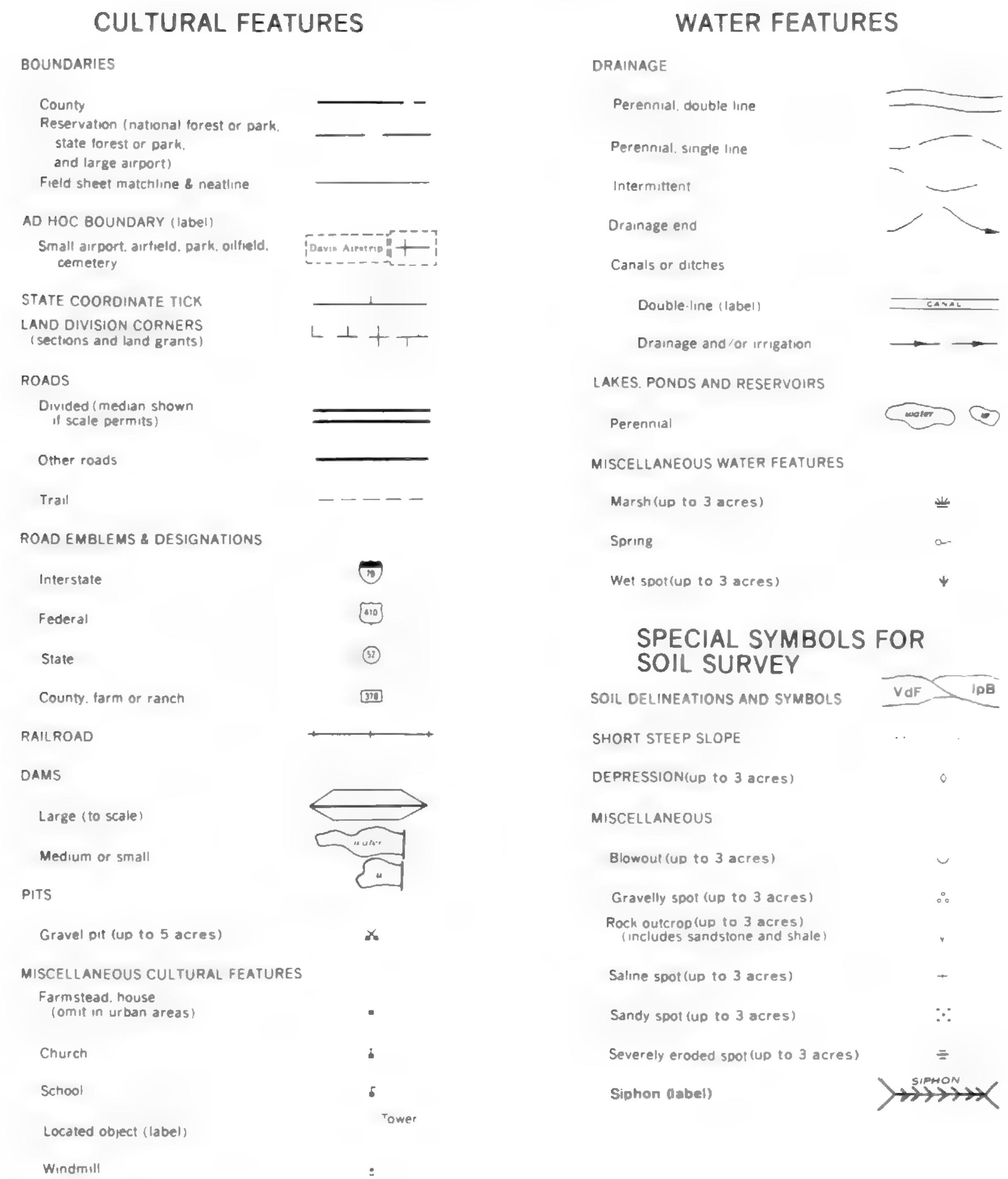
Scale 1:253,440

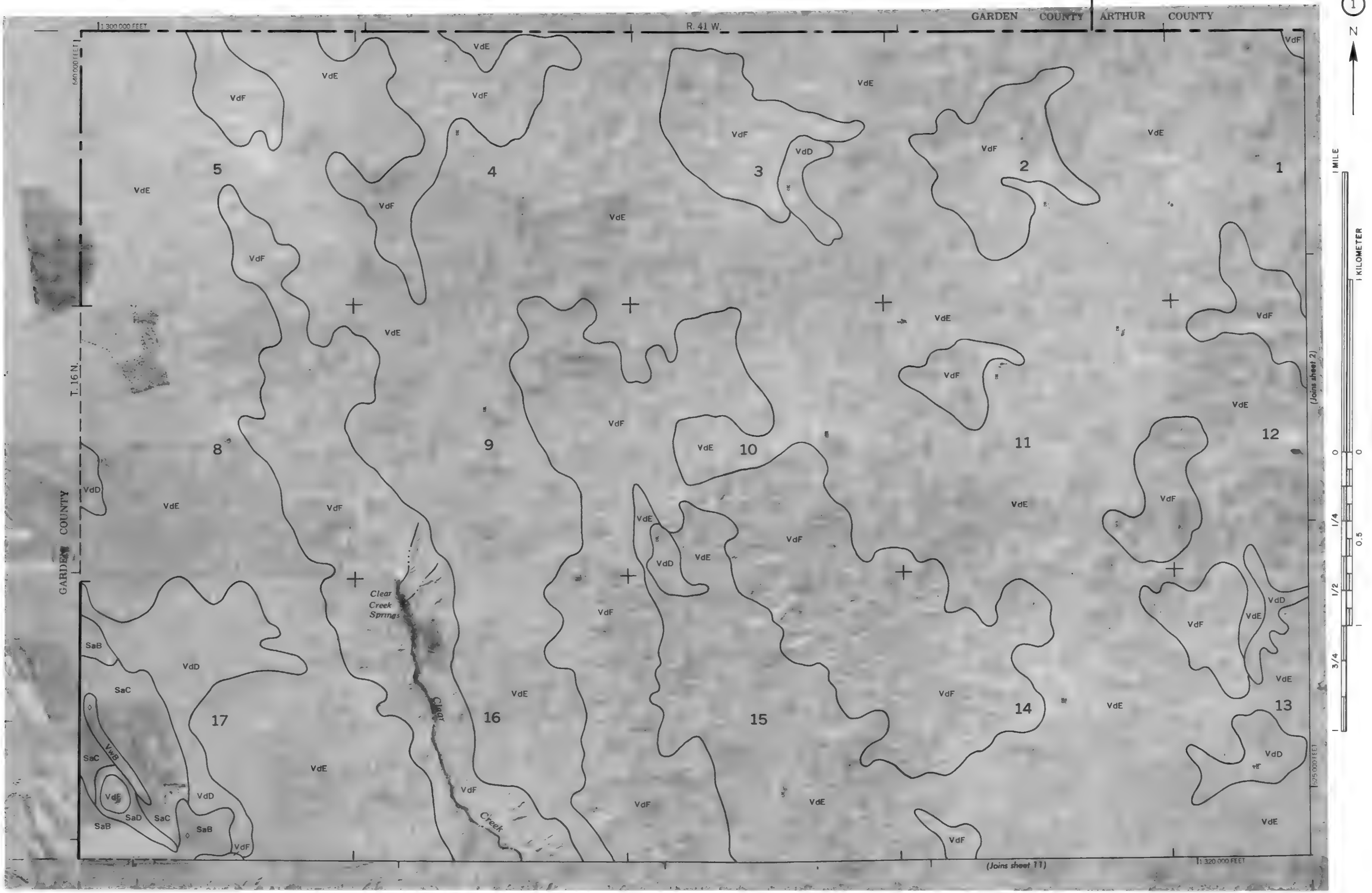
SOIL LEGEND

Map symbols consist of a combination of letters or of letters and a number. The first capital letter is the initial one of the map unit name. The lowercase letter that follows separates map units having names that begin with the same letter, except that it does not separate sloping or eroded phases. The second capital letter indicates the class of slope. Symbols without a slope letter are for nearly level soils or miscellaneous areas. A final number of 2 indicates that the soil is eroded.

SYMBOL	NAME
Ad	Aida fine sandy loam, 0 to 2 percent slopes
AwF	Altvan-Dix complex, 6 to 30 percent slopes
Bb	Bankard sand, 0 to 2 percent slopes
Bc	Bankard loamy sand, 0 to 2 percent slopes
Bd	Bankard loamy sand, channeled
BeB	Bayard very fine sandy loam, 1 to 3 percent slopes
Bo	Boel loamy fine sand, 0 to 2 percent slopes
Bs	Bridget silt loam, 0 to 1 percent slopes
BtB	Briget loam, 1 to 3 percent slopes
ChB	Chappell fine sandy loam, 0 to 3 percent slopes
Cu	Cullison fine sandy loam, 0 to 2 percent slopes
Cz	Cullison loam, wet, 0 to 2 percent slopes
DfE	Dix gravelly loam, 3 to 20 percent slopes
DsG	Dix-Sully-Sarben complex, 20 to 60 percent slopes
Dt	Duroc loam, terrace, 0 to 1 percent slopes
DtB	Duroc loam, terrace, 1 to 3 percent slopes
Du	Duroc silt loam, 0 to 1 percent slopes
DuB	Duroc silt loam, 1 to 3 percent slopes
Fu	Fluvaquents, sandy
Go	Gothenburg loamy sand, 0 to 2 percent slopes
IpB	Ipage fine sand, 0 to 3 percent slopes
Ja	Janise loam, 0 to 2 percent slopes
Jd	Janise loam, drained, 0 to 2 percent slopes
KeB	Keith loam, 1 to 3 percent slopes
KeC	Keith loam, 3 to 6 percent slopes
Ku	Kuma loam, 0 to 1 percent slopes
KuB	Kuma loam, 1 to 3 percent slopes
La	Lawet loam, 0 to 2 percent slopes
Le	lex loam, 0 to 2 percent slopes
Lp	Lodgepole silt loam, 0 to 1 percent slopes
Ma	Marlake fine sandy loam, 0 to 1 percent slopes
Me	Merrick loam, 0 to 2 percent slopes
No	Norwest loam, 0 to 2 percent slopes
Pp	Pits and dumps
Pt	Platte loam, 0 to 2 percent slopes
RtB	Rosebud loam, 1 to 3 percent slopes
RtD	Rosebud loam, 3 to 9 percent slopes
SaB	Sarben loamy fine sand, 0 to 3 percent slopes
SaC	Sarben loamy fine sand, 3 to 6 percent slopes
SaD	Sarben loamy fine sand, 6 to 9 percent slopes
SaE	Sarben loamy fine sand, 9 to 20 percent slopes
Sb	Satanta loam, 0 to 1 percent slopes
SbB	Satanta loam, 1 to 3 percent slopes
SbC	Satanta loam, 3 to 6 percent slopes
ScD	Satanta-Dix complex, 3 to 9 percent slopes
SfD	Sully loam, 6 to 9 percent slopes
SfG	Sully loam, 30 to 60 percent slopes
SkE	Sully-Dix complex, 9 to 20 percent slopes
SmE2	Sully-McConaughy complex, 9 to 20 percent slopes, eroded
SmF	Sully-McConaughy complex, 9 to 30 percent slopes
TaG	Tassel-Otero-Rock outcrop complex, 15 to 60 percent slopes
VdB	Valent fine sand, 0 to 3 percent slopes
VdD	Valent fine sand, 3 to 9 percent slopes
VdE	Valent fine sand, rolling
VdF	Valent fine sand, rolling and hilly
VgG	Valent fine sand, gullied, 30 to 60 percent slopes
VtG	Valent-Tassel-Rock outcrop complex, 9 to 60 percent slopes
VwB	Vetal loamy fine sand, 0 to 3 percent slopes
Wa	Wann fine sandy loam, 0 to 2 percent slopes

CONVENTIONAL AND SPECIAL SYMBOLS LEGEND

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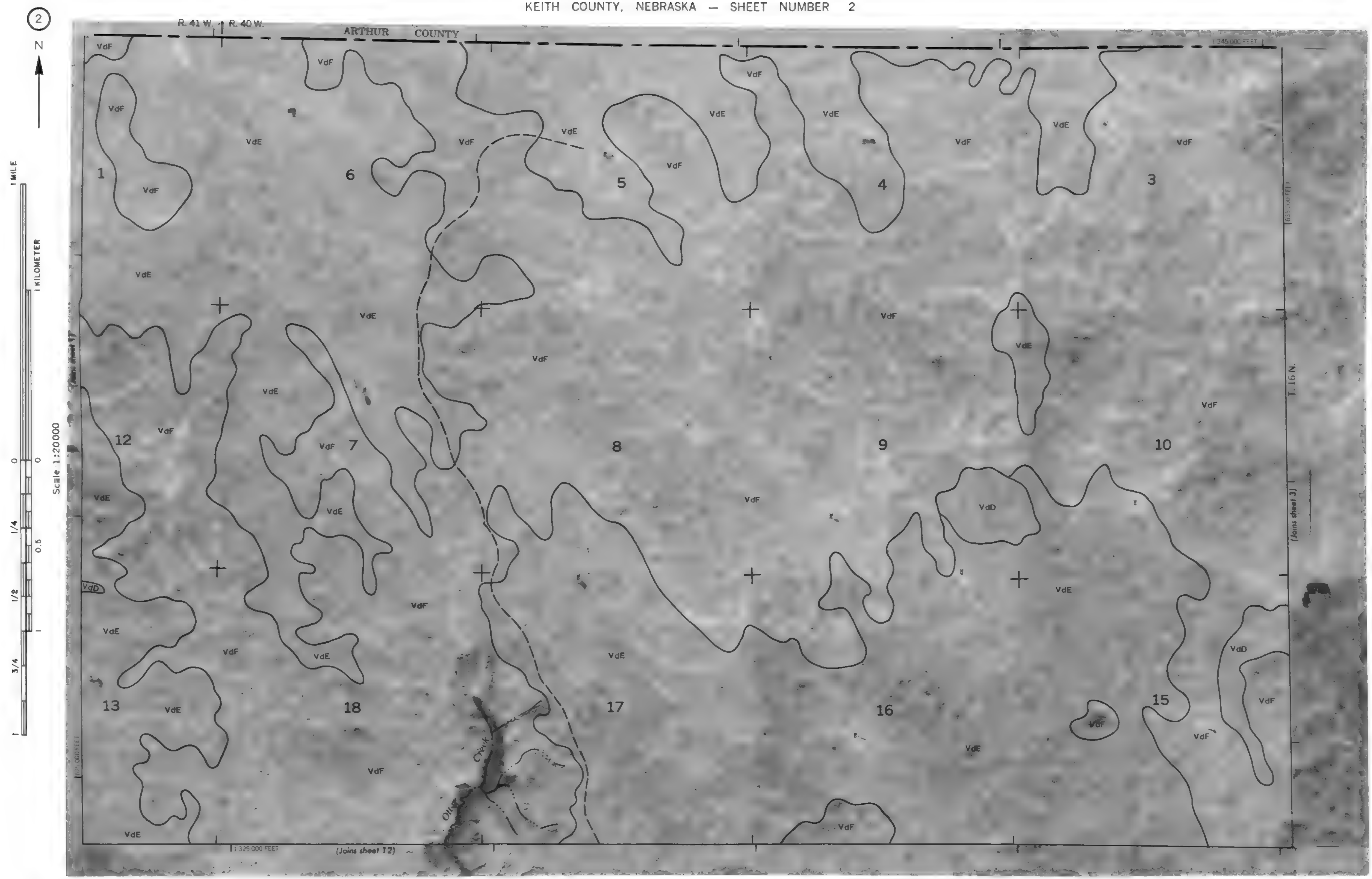
N
GARDEN COUNTY
ARTHUR COUNTY
R. 41 W.
T. 16 N.
GARDEN COUNTY
1 300 000 FEET
640 000 FEET
625 000 FEET
1 320 000 FEET
(Joins sheet 2)
(Joins sheet 11)
1 MILE
1 KILOMETER
0
1/4
1/2
3/4
0.5
Scale 1:20000
Clear Creek Springs
Clear
Creek
1
2
3
4
5
8
9
10
11
12
13
14
15
16
17
VdE
VdF
VdD
SaB
SaC
SaD
VwB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1 KILOMETER
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1/4
1/2
3/4
1
0
0.5
1
R. 41 W.
R. 40 W.
ARTHUR COUNTY
1 345 000 FEET
T. 16 N.
(Joins sheet 1)
(Joins sheet 3)
(Joins sheet 12)
1 325 000 FEET
Olive Creek
1
6
5
4
3
12
7
8
9
10
13
18
17
16
15
VdF
VdE
VdD
VdF
VdE
VdF
VdE
VdF
VdE
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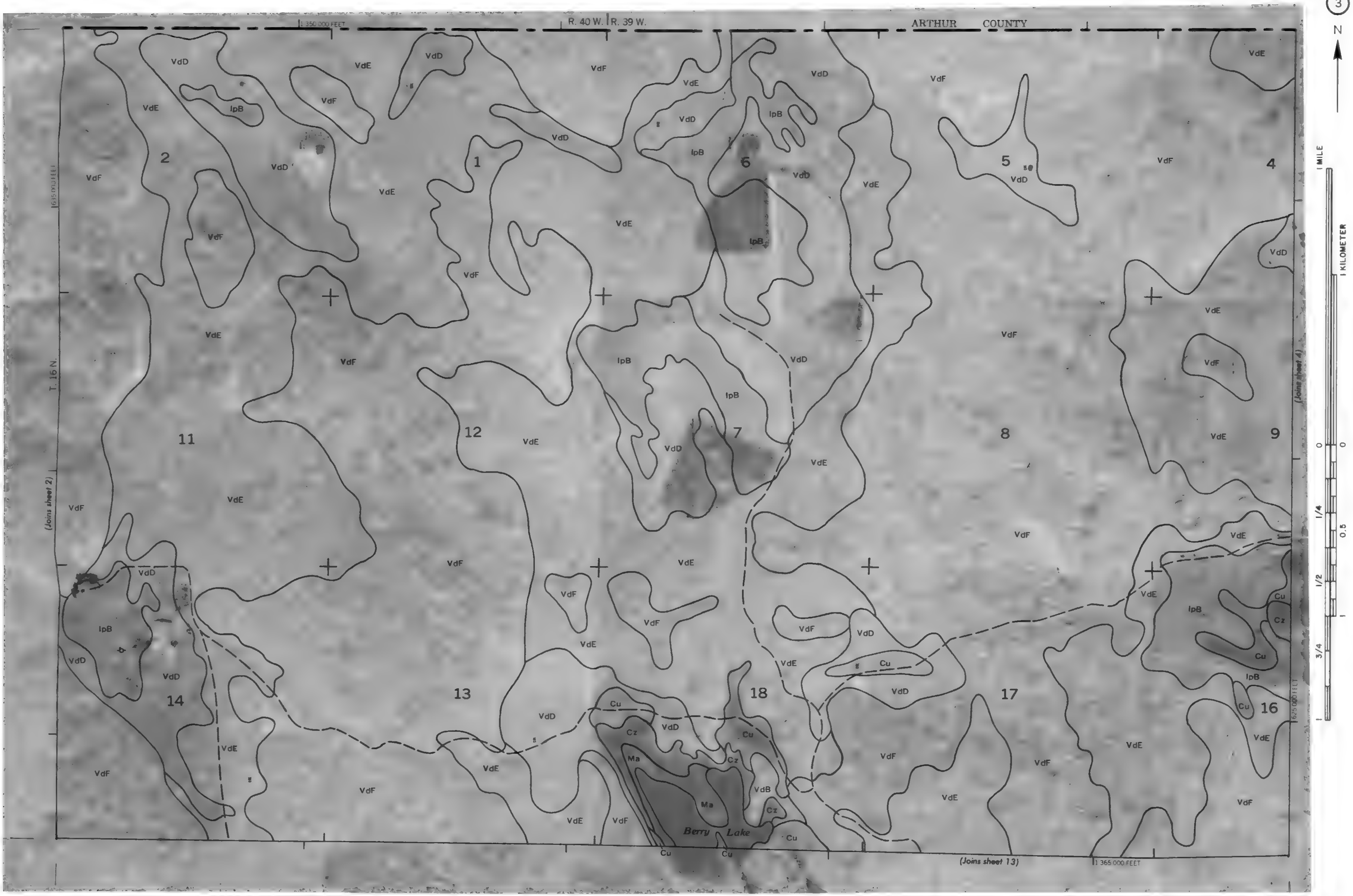
VdE
VdF
VdE
VdD
VdF
VdE
VdF
VdE
VdD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R. 40 W.
R. 39 W.
ARTHUR COUNTY
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T. 16 N.
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(Joins sheet 4)
(Joins sheet 13)
1 365 000 FEET
Berry Lake
1 MILE
1 KILOMETER
Scale 1:20000
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1/4
1/2
3/4
1
0
0.5
1
VdD
VdE
VdF
IpB
VdB
Cu
Cz
Ma
1
2
4
5
6
7
8
9
11
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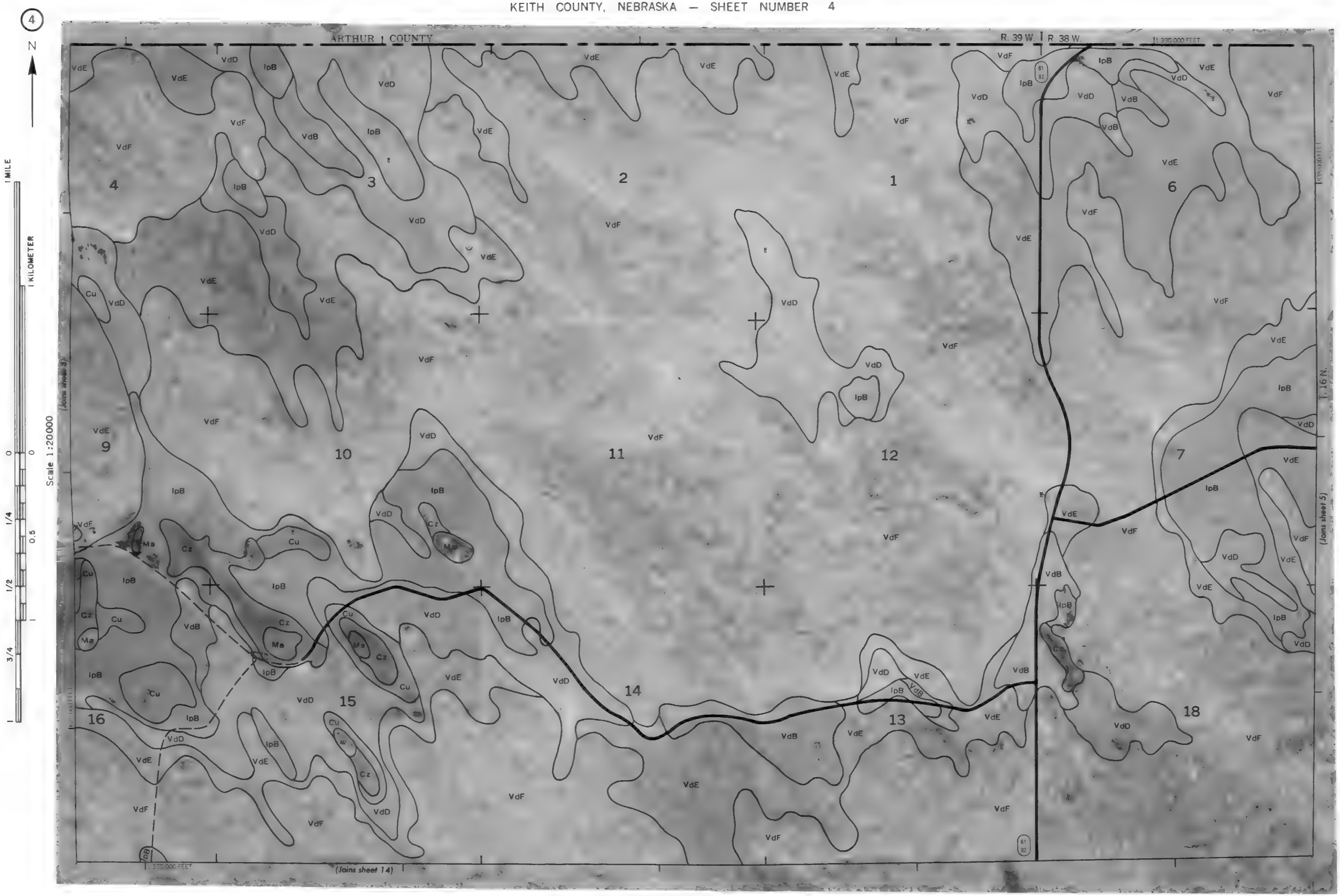
13
14
16
17
18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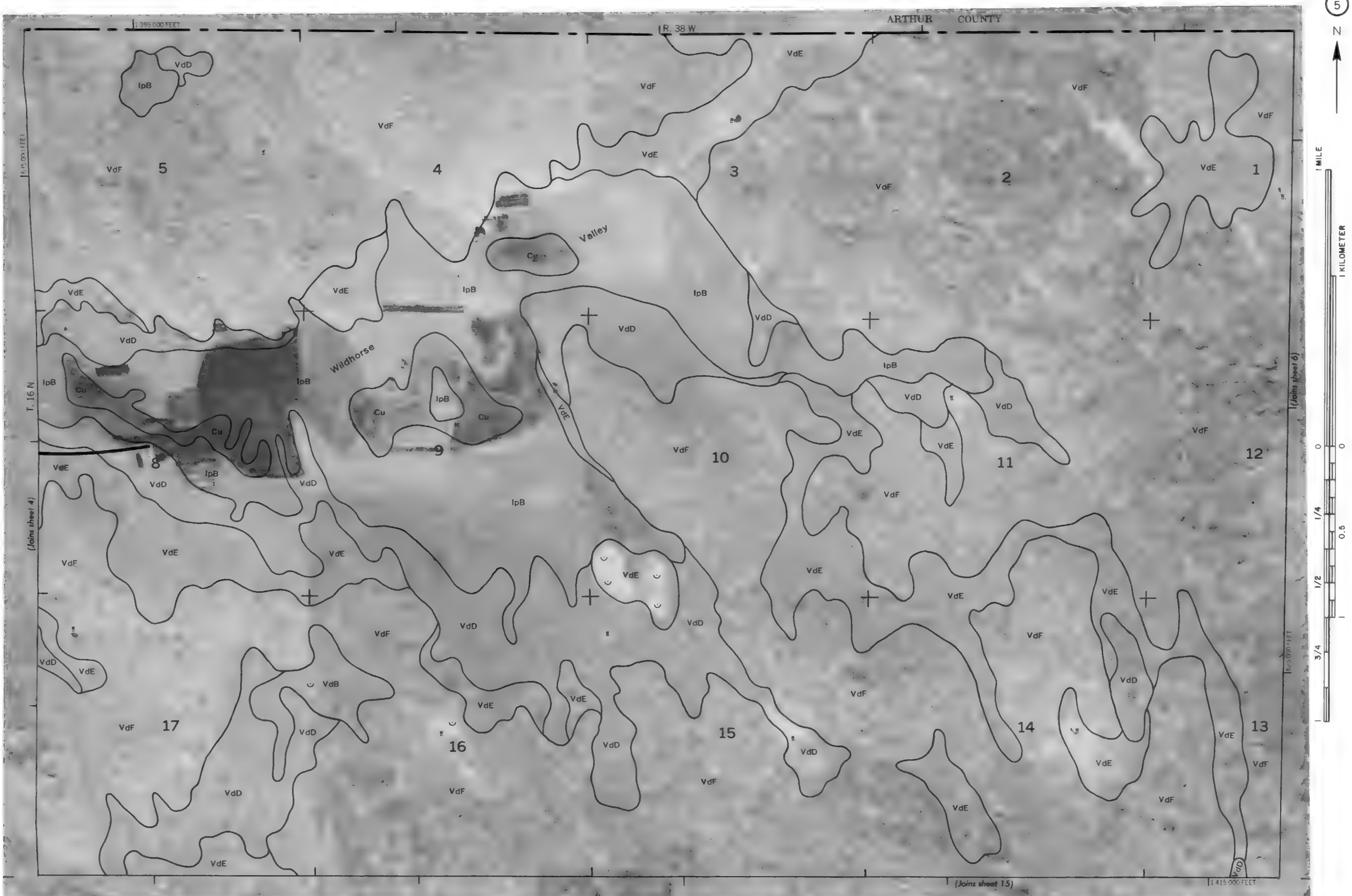
N
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
1
0
0.5
1
ARTHUR COUNTY
R. 39 W.
R. 38 W.
T. 16 N.
(Joins sheet 3)
(Joins sheet 5)
(Joins sheet 14)
1 2 3 4 6 7 9 10 11 12 13 14 15 16 18
VdE
VdD
VdF
VdB
IpB
Cu
Cz
Ma
61
92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N
ARTHUR COUNTY
R. 38 W
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T. 16 N
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(Joins sheet 6)
(Joins sheet 15)
1 415 000 FEET
Wildhorse
Valley
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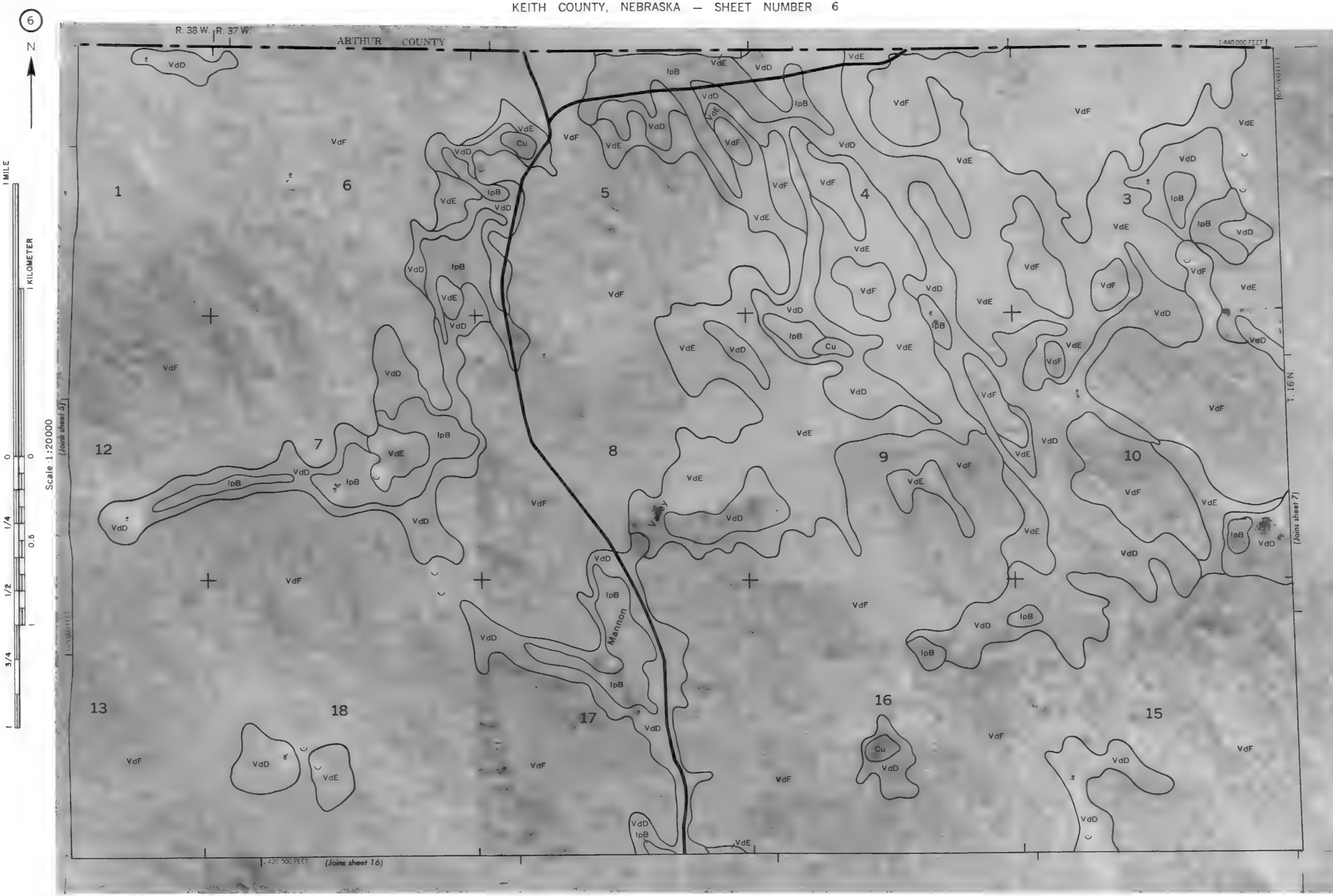
1 KILOMETER
Scale 1:20000
VdD
IpB
VdF
VdE
Cu
VdB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N
1 MILE
0
1/4
1/2
3/4
1
1 KILOMETER
0
0.5
1
Scale 1:20000
(Joins sheet 5)
(Joins sheet 7)
(Joins sheet 16)
R. 38 W.
R. 37 W.
ARTHUR COUNTY
T. 16 N.
1 440 000 FEET
420 000 FEET
1
2
3
4
5
6
7
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12
13
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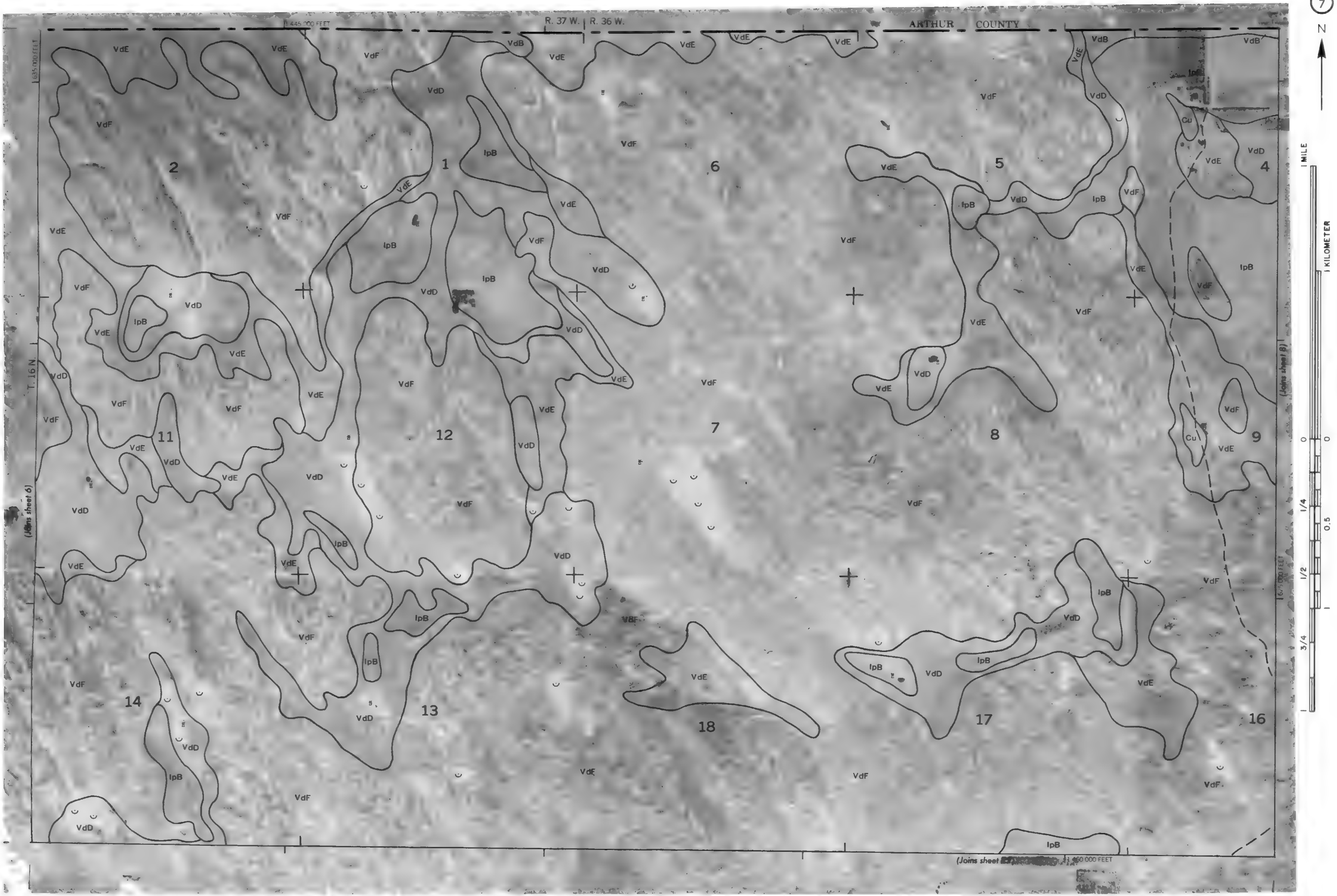
16
17
18
VdD
VdE
VdF
IpB
Cu
Valley
Mannon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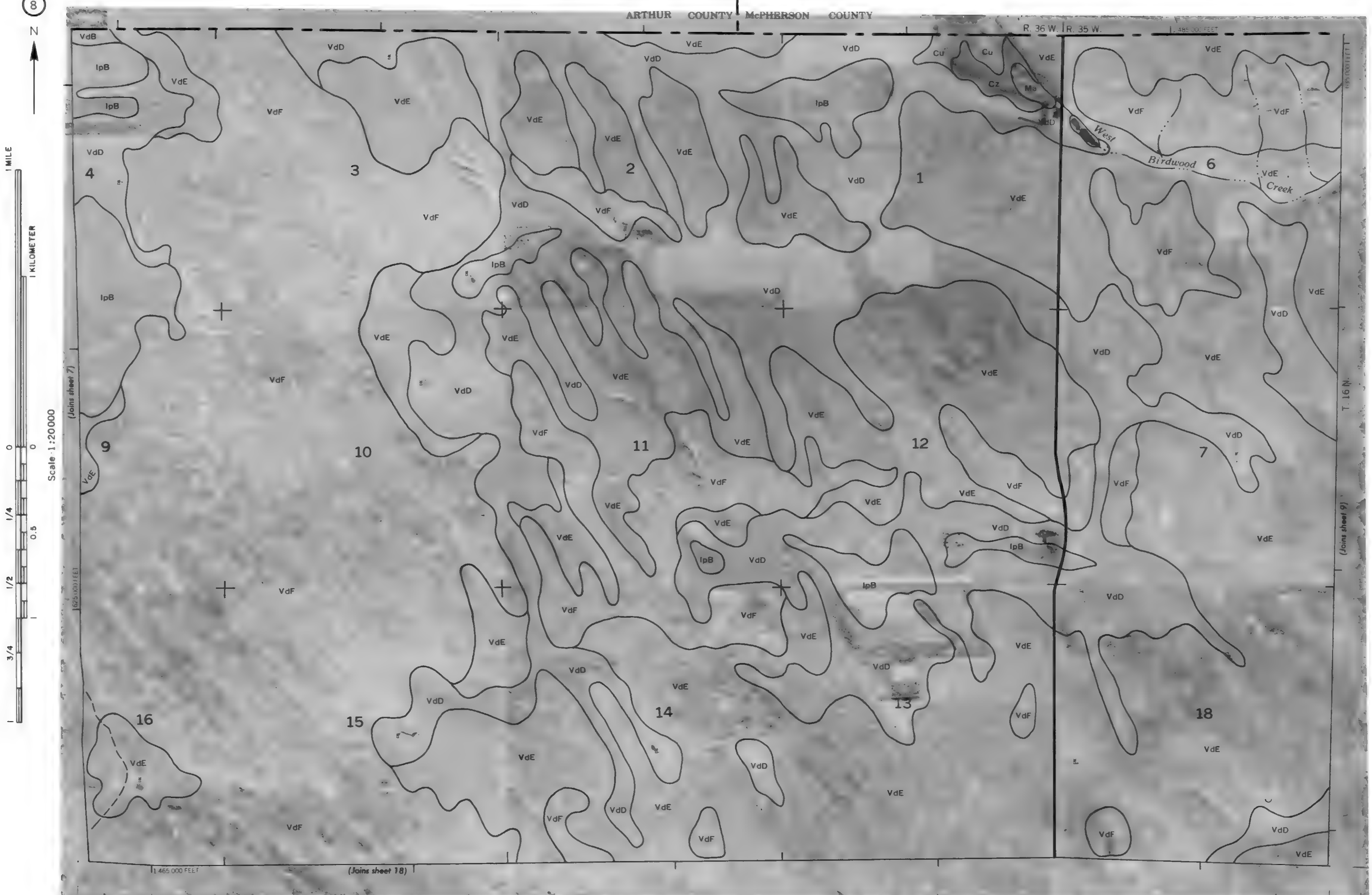
N
ARTHUR COUNTY
R. 37 W. | R. 36 W.
1 445 000 FEET
T. 16 N.
(Joins sheet 6)
(Joins sheet 8)
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
1
0.5
VdE
VdF
VdD
VdB
IpB
Cu
1
2
4
5
6
7
8
9
11
12
13
14
16
17
18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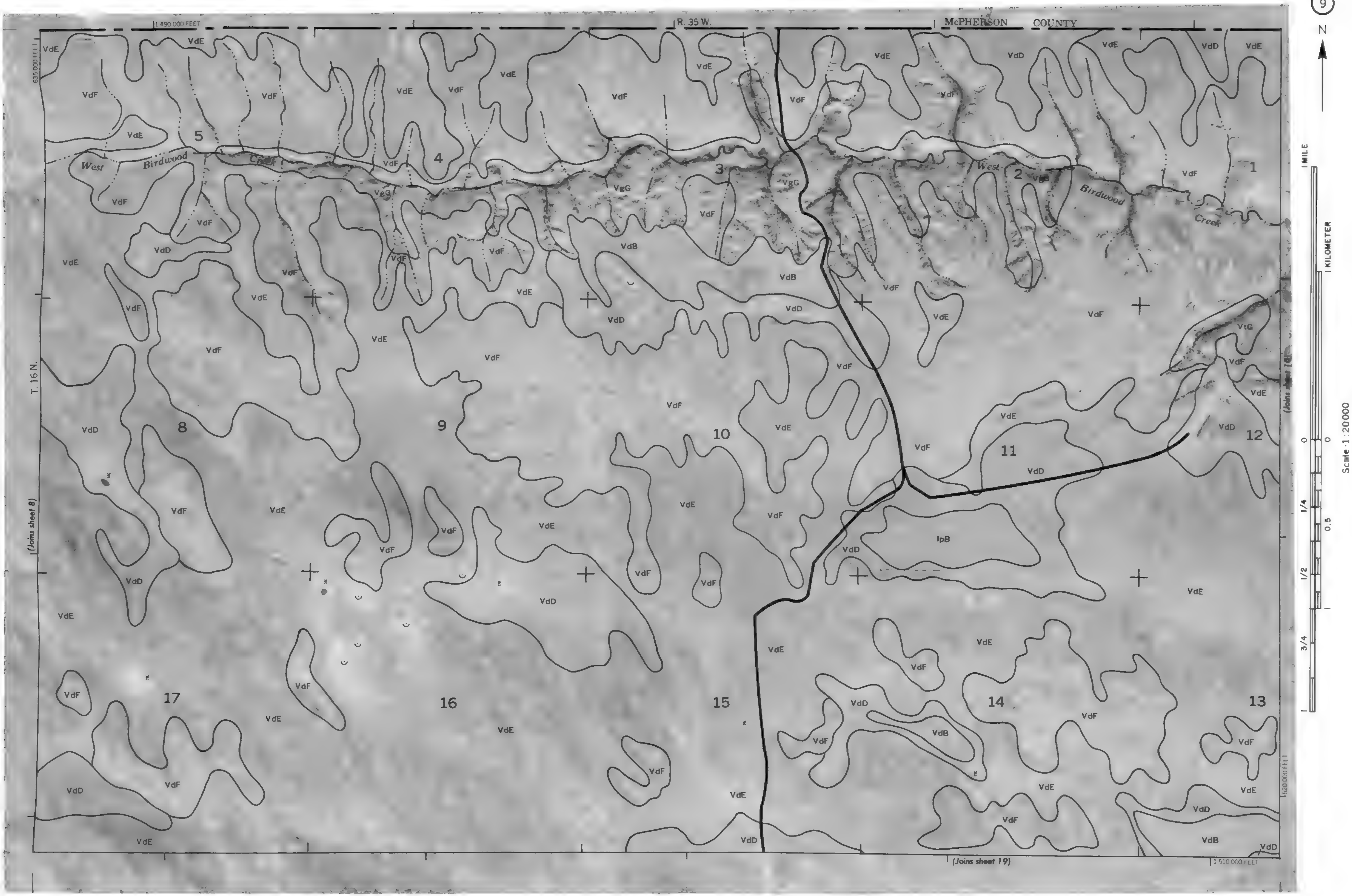
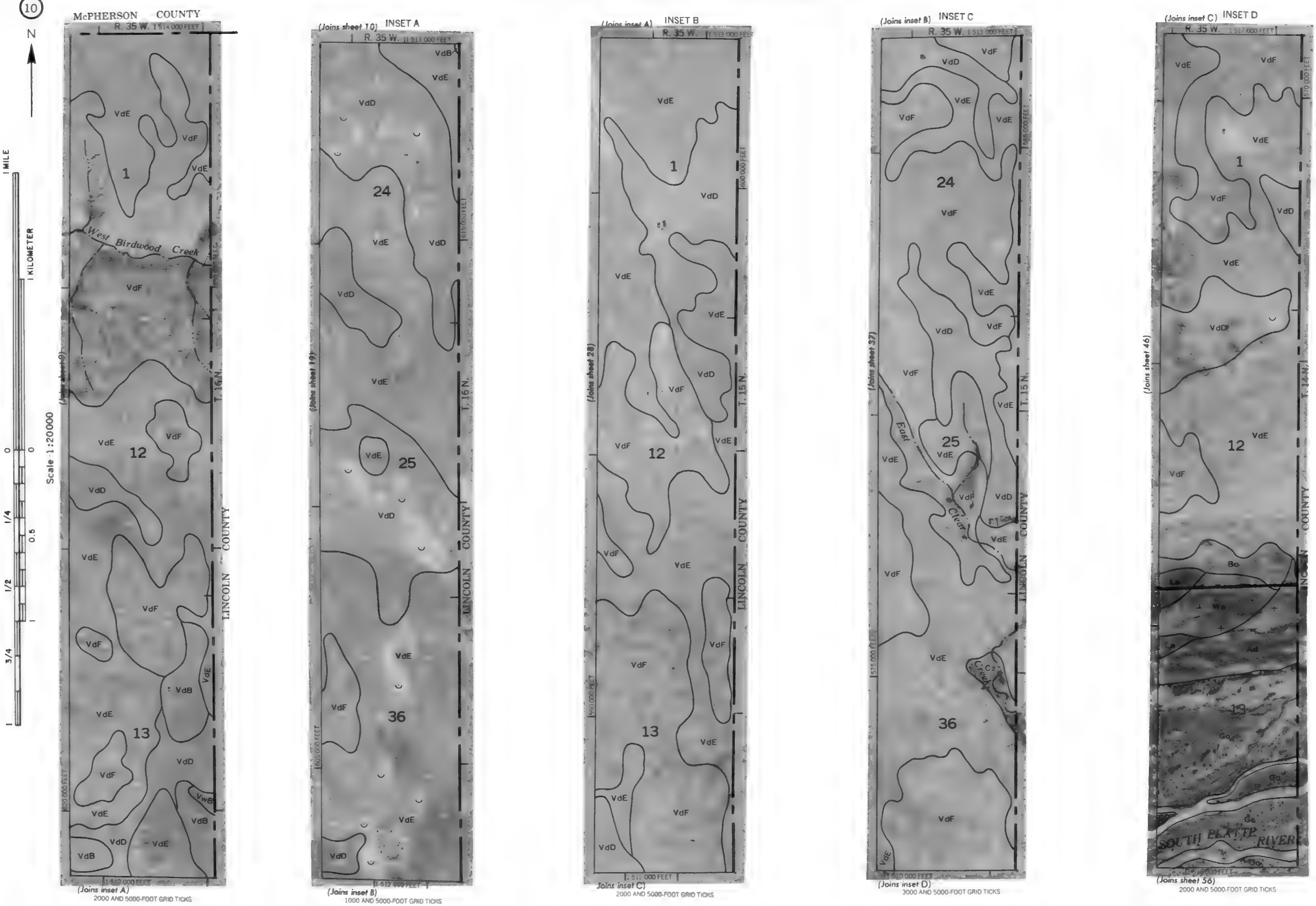
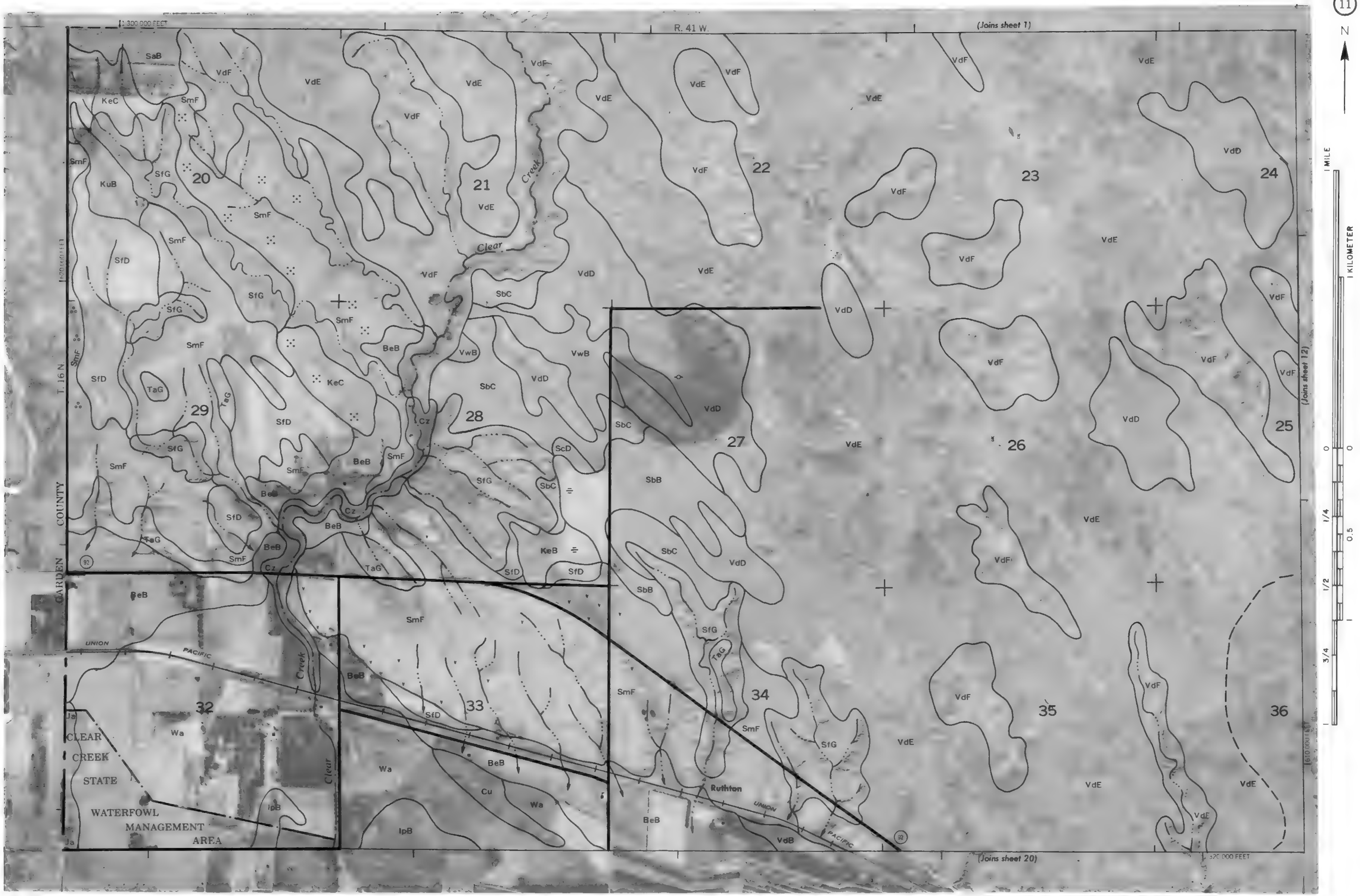
N
1 MILE
1 KILOMETER
0
1/4
1/2
3/4
1
0
0.5
Scale 1:20000
ARTHUR COUNTY
McPHERSON COUNTY
R. 36 W.
R. 35 W.
T. 16 N.
(Joins sheet 7)
(Joins sheet 9)
(Joins sheet 18)
1 465 000 FEET
West Birdwood Creek
1
2
3
4
6
7
9
10
11
12
13
14
15
16
18
VdB
IpB
VdE
VdF
VdD
Cu
Cz
Ma

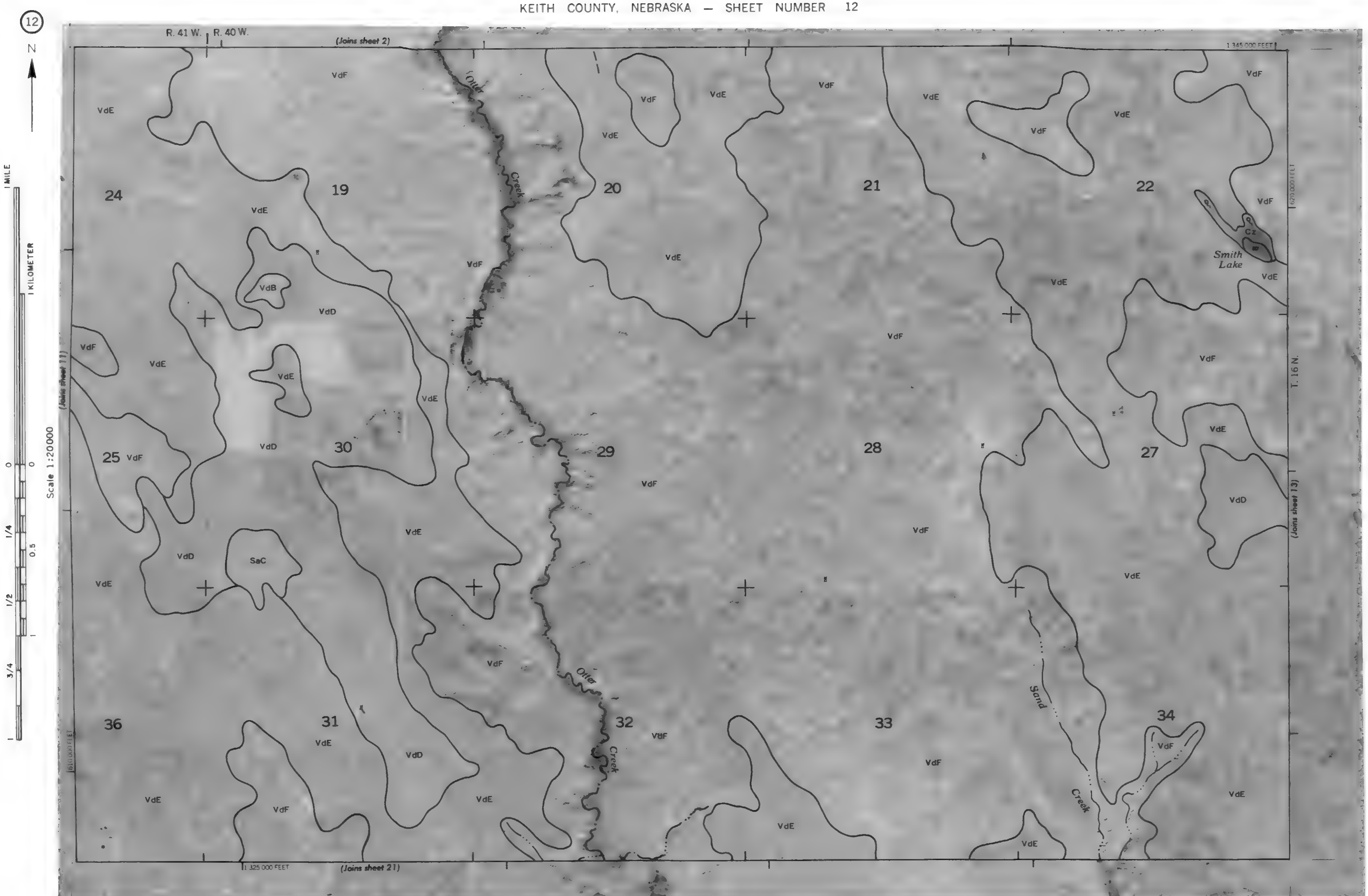

9
N
McPHERSON COUNTY
R. 35 W.
1 490 000 FEET
635 000 FEET
T. 16 N.
(Joins sheet 8)
(Joins sheet 10)
(Joins sheet 19)
1 510 000 FEET
620 000 FEET
West Birdwood Creek
1
2
3
4
5
8
9
10
11
12
13
14
15
16
17
VdB
VdD
VdE
VdF
VgG
VtG
IpB
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
0.5

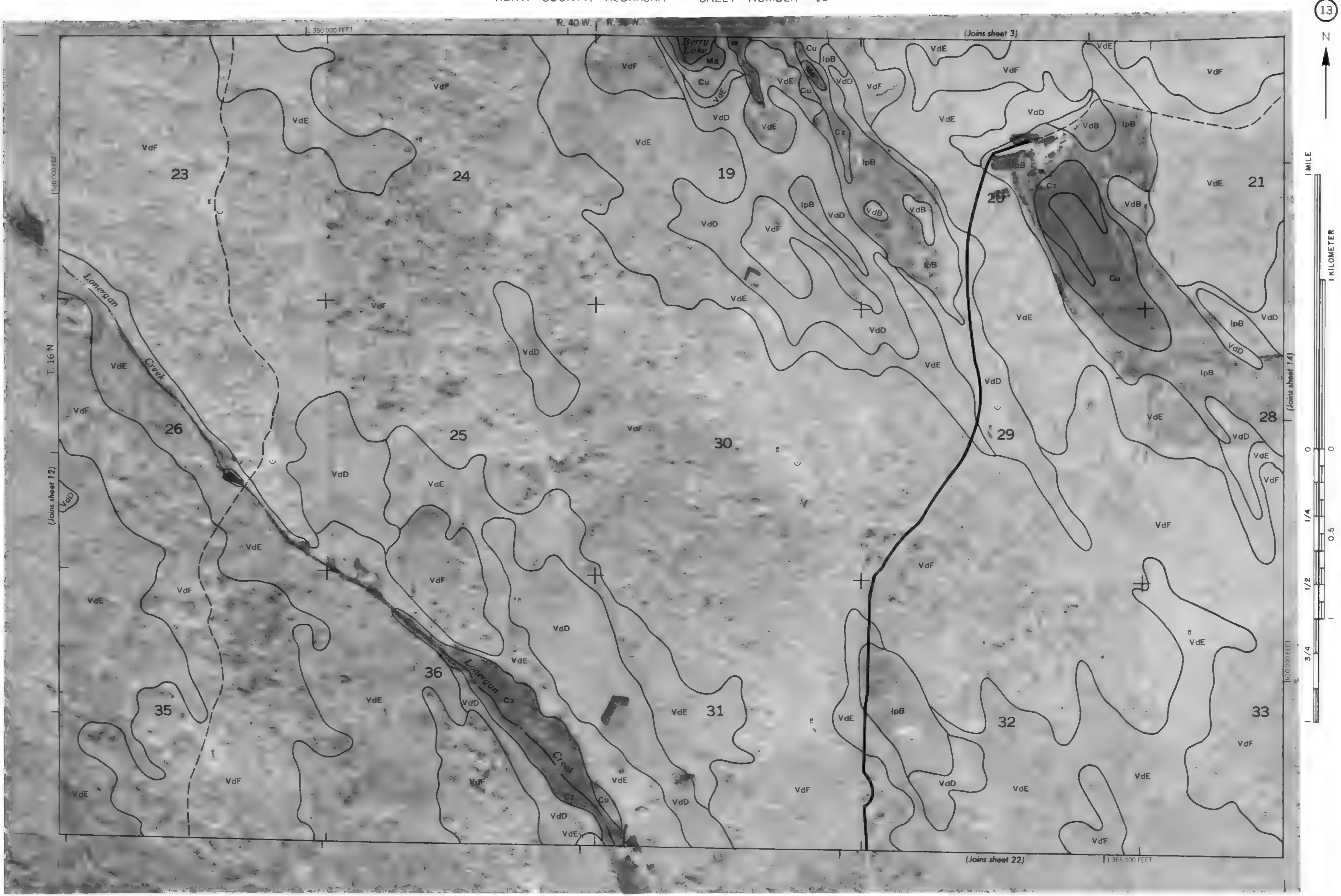


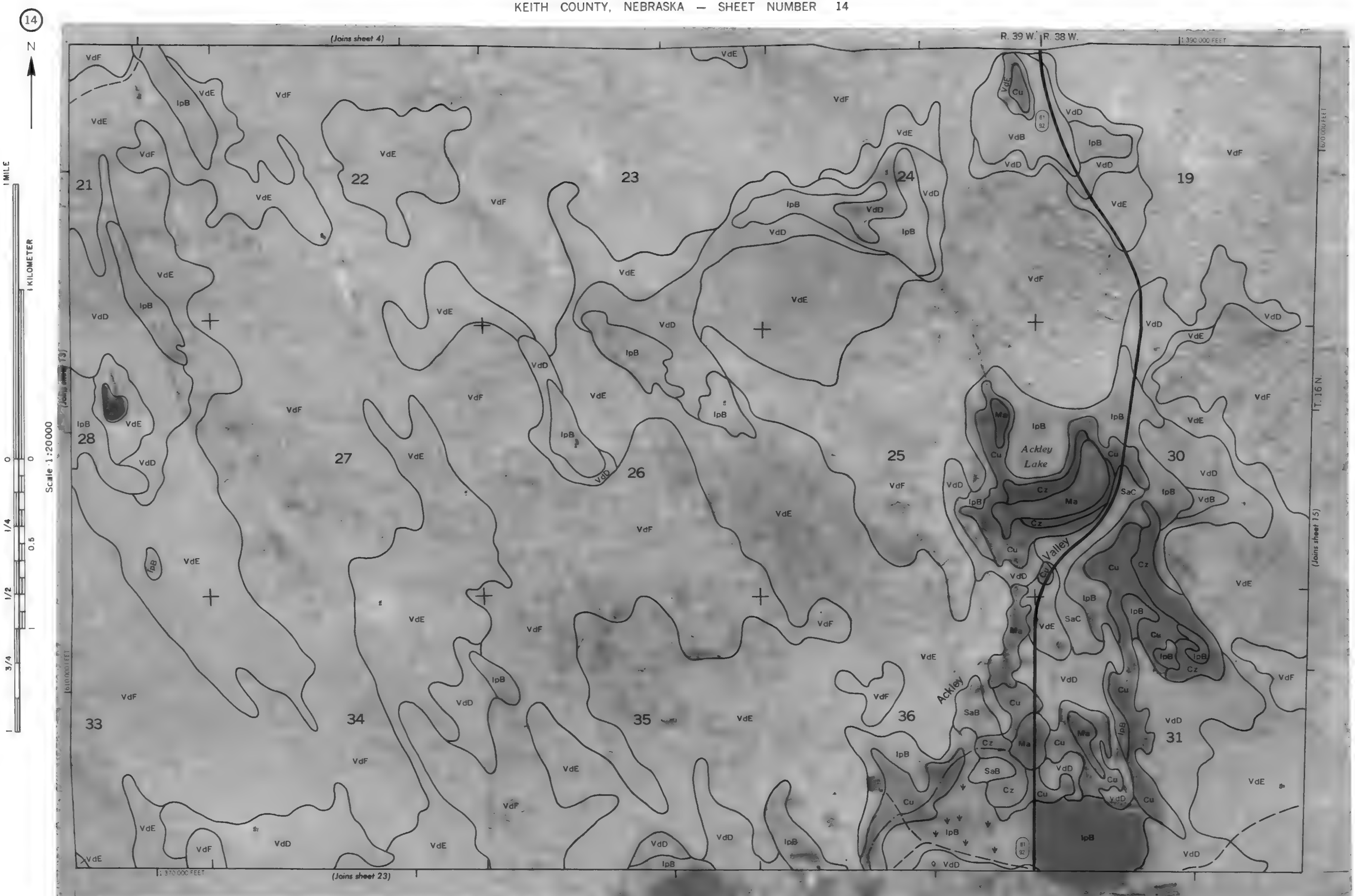
10
McPHERSON COUNTY
N
1 MILE
1 KILOMETER
Scale 1:20000
R. 35 W.
West Birdwood Creek
T. 16 N.
LINCOLN COUNTY
(Joins inset A)
2000 AND 5000-FOOT GRID TICKS
(Joins sheet 10) INSET A
(Joins sheet 19)
(Joins inset B)
1000 AND 5000-FOOT GRID TICKS
(Joins inset A) INSET B
(Joins sheet 28)
T. 15 N.
(Joins inset C)
2000 AND 5000-FOOT GRID TICKS
(Joins inset B) INSET C
(Joins sheet 37)
East
Clear
Creek
(Joins inset D)
3000 AND 5000-FOOT GRID TICKS
(Joins inset C) INSET D
(Joins sheet 46)
T. 14 N.
SOUTH PLATTE RIVER
(Joins sheet 56)
2000 AND 5000-FOOT GRID TICKS
1
12
13
24
25
36
VdB
VdD
VdE
VdF
VwB
Bo
Le
We
Ad
Go

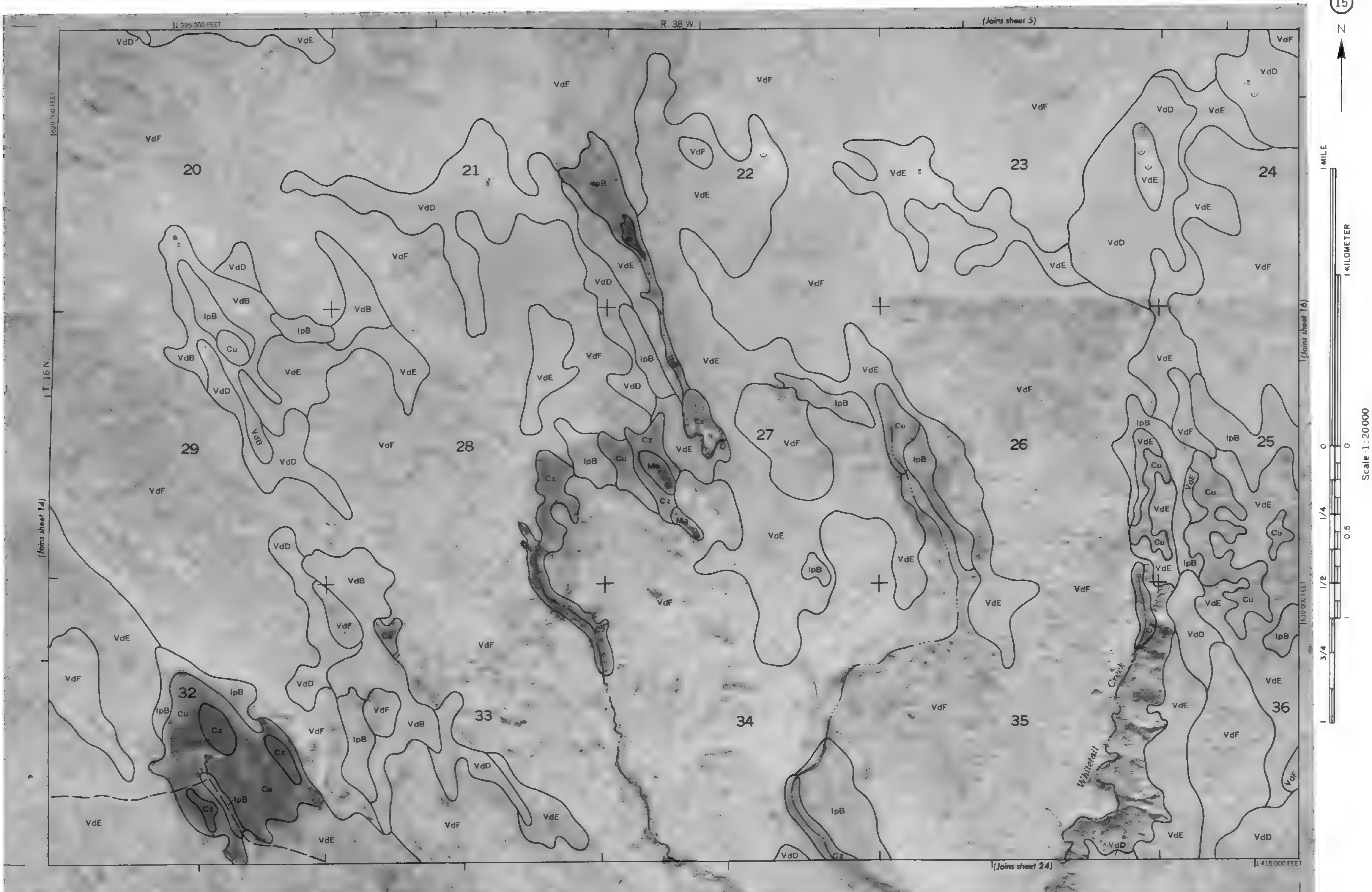


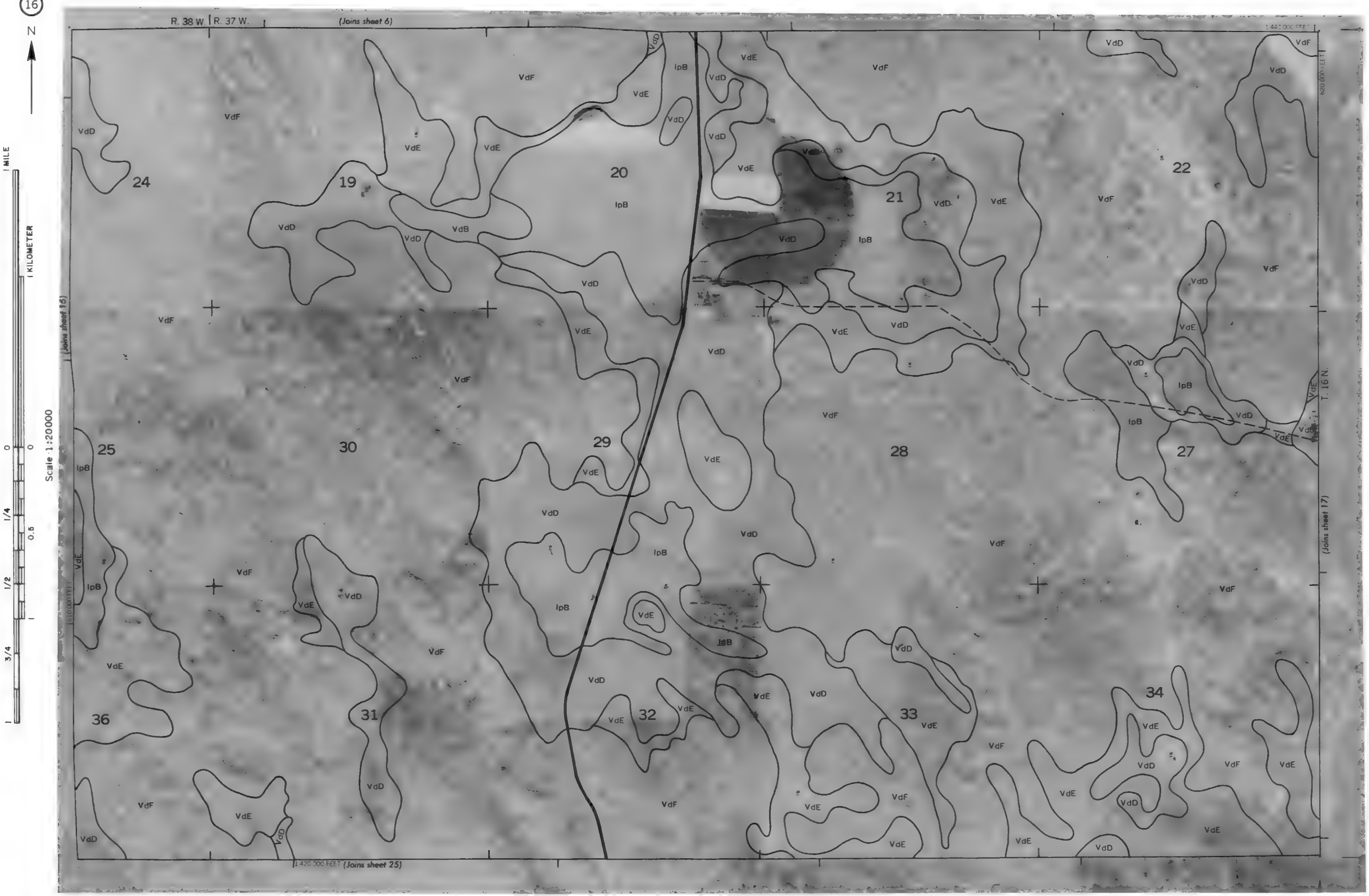
R. 41 W.
(Joins sheet 1)
(Joins sheet 12)
(Joins sheet 20)
T. 16 N.
GARDEN COUNTY
N
1 MILE
1 KILOMETER
Scale 1:20000
Clear
Creek
CLEAR
CREEK
STATE
WATERFOWL
MANAGEMENT
AREA
UNION
PACIFIC
Ruthton
20
21
22
23
24
25
26
27
28
29
32
33
34
35
36
SaB
KeC
KuB
SmF
SfG
SfD
TaG
VdF
VdE
VdD
SbC
SbB
ScD
BeB
VwB
KeB
Cz
Wa
Ja
IpB
Cu
VdB

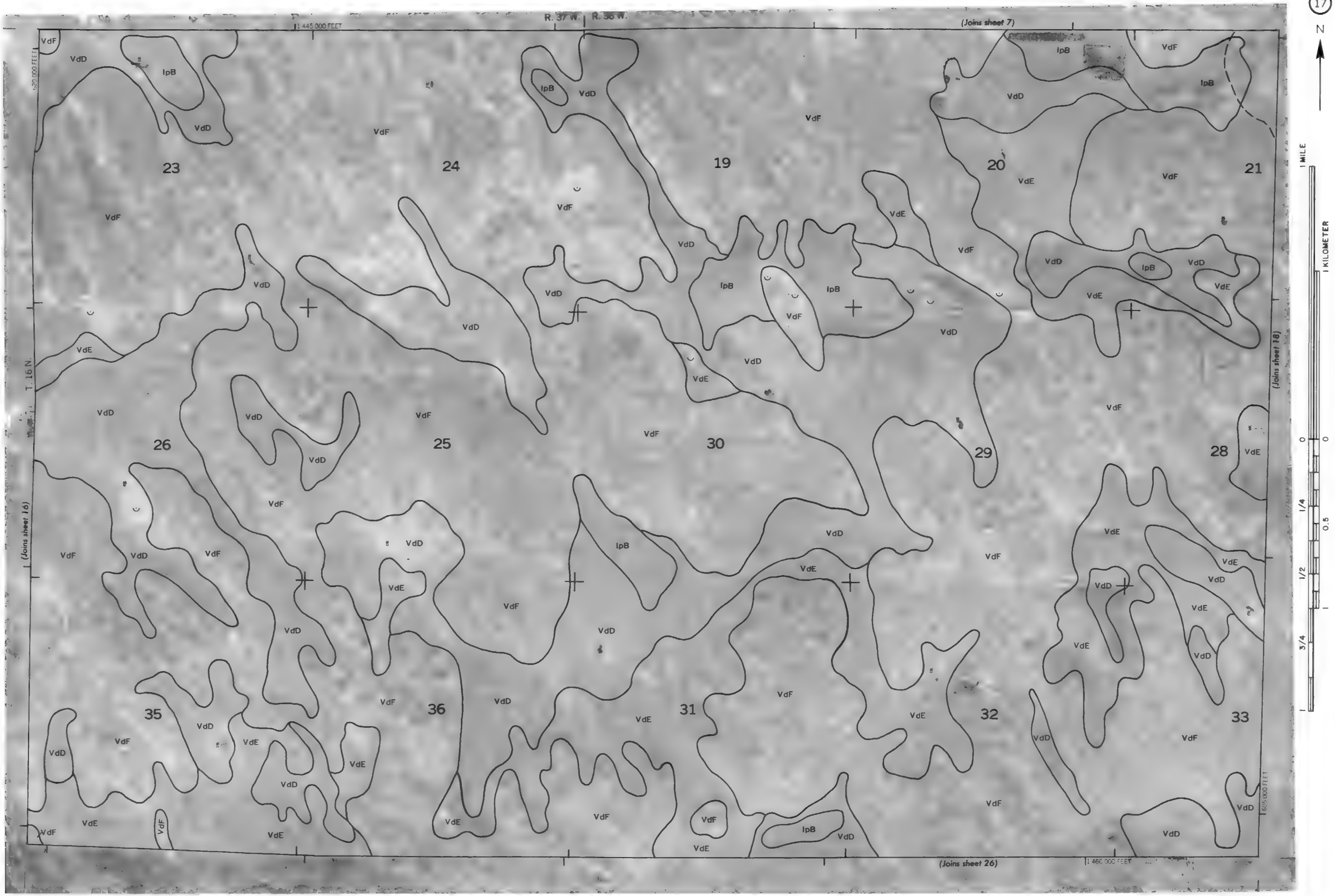

12
N
R. 41 W.
R. 40 W.
(Joins sheet 2)
(Joins sheet 11)
(Joins sheet 13)
(Joins sheet 21)
1 345 000 FEET
1 325 000 FEET
T. 16 N.
Scale 1:20000
1 MILE
1 KILOMETER
0
1/4
1/2
3/4
1
0.5
Otter Creek
Sand Creek
Smith Lake
24
19
20
21
22
25
30
29
28
27
36
31
32
33
34
VdE
VdF
VdD
VdB
SaC
Cz

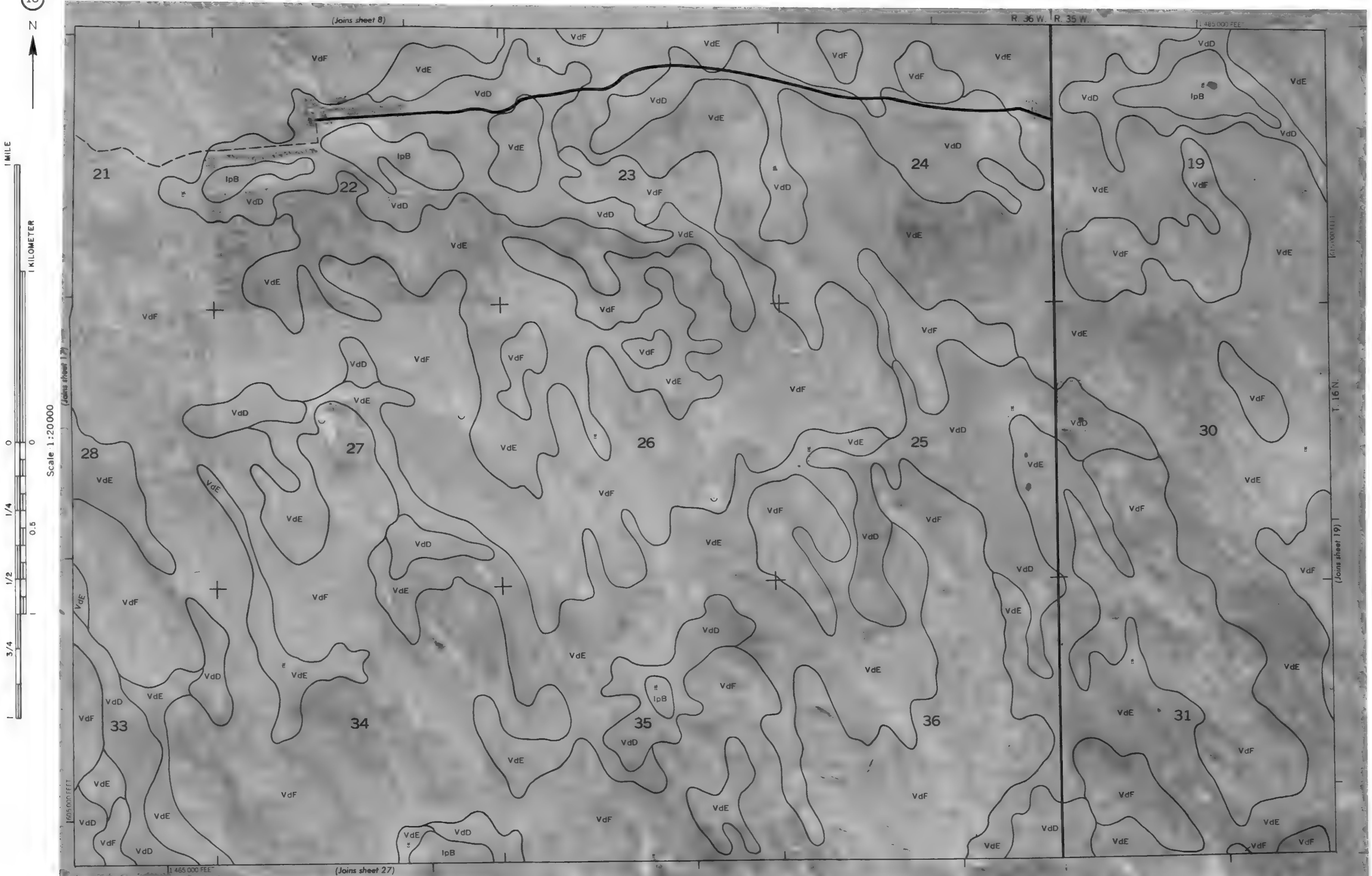

13
N
R. 40 W.
1 350 000 FEET
(Joins sheet 3)
(Joins sheet 12)
(Joins sheet 14)
(Joins sheet 22)
1 365 000 FEET
620 000 FEET
610 000 FEET
T. 16 N.
Berry Lake
Lonergan Creek
23
24
19
20
21
26
25
30
29
28
36
35
31
32
33
VdF
VdE
VdD
VdB
IpB
Cu
Cz
Ma
1 MILE
1 KILOMETER
0
1/4
1/2
3/4
1
0.5
Scale 1:20000

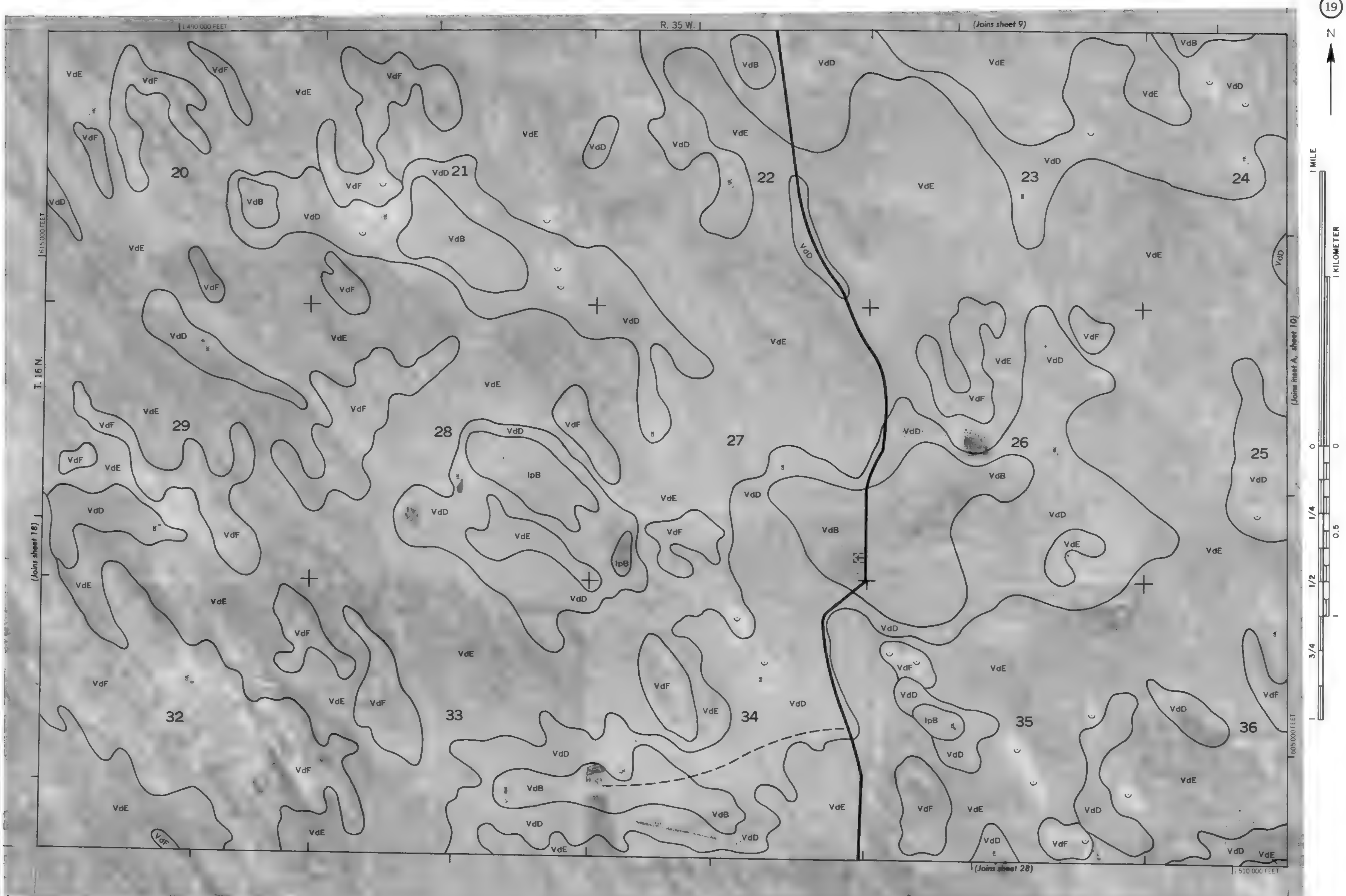

14
N
1 MILE
1 KILOMETER
0
1/4
1/2
3/4
1
0.5
Scale 1:20000
(Joins sheet 4)
(Joins sheet 23)
(Joins sheet 13)
(Joins sheet 15)
R. 39 W.
R. 38 W.
T. 16 N.
1 390 000 FEET
1 370 000 FEET
610 000 FEET
21
22
23
24
19
28
27
26
25
30
33
34
35
36
31
Ackley Lake
Ackley Valley
VdF
VdE
VdD
VdB
IpB
Cu
Cz
Ma
SaC
SaB

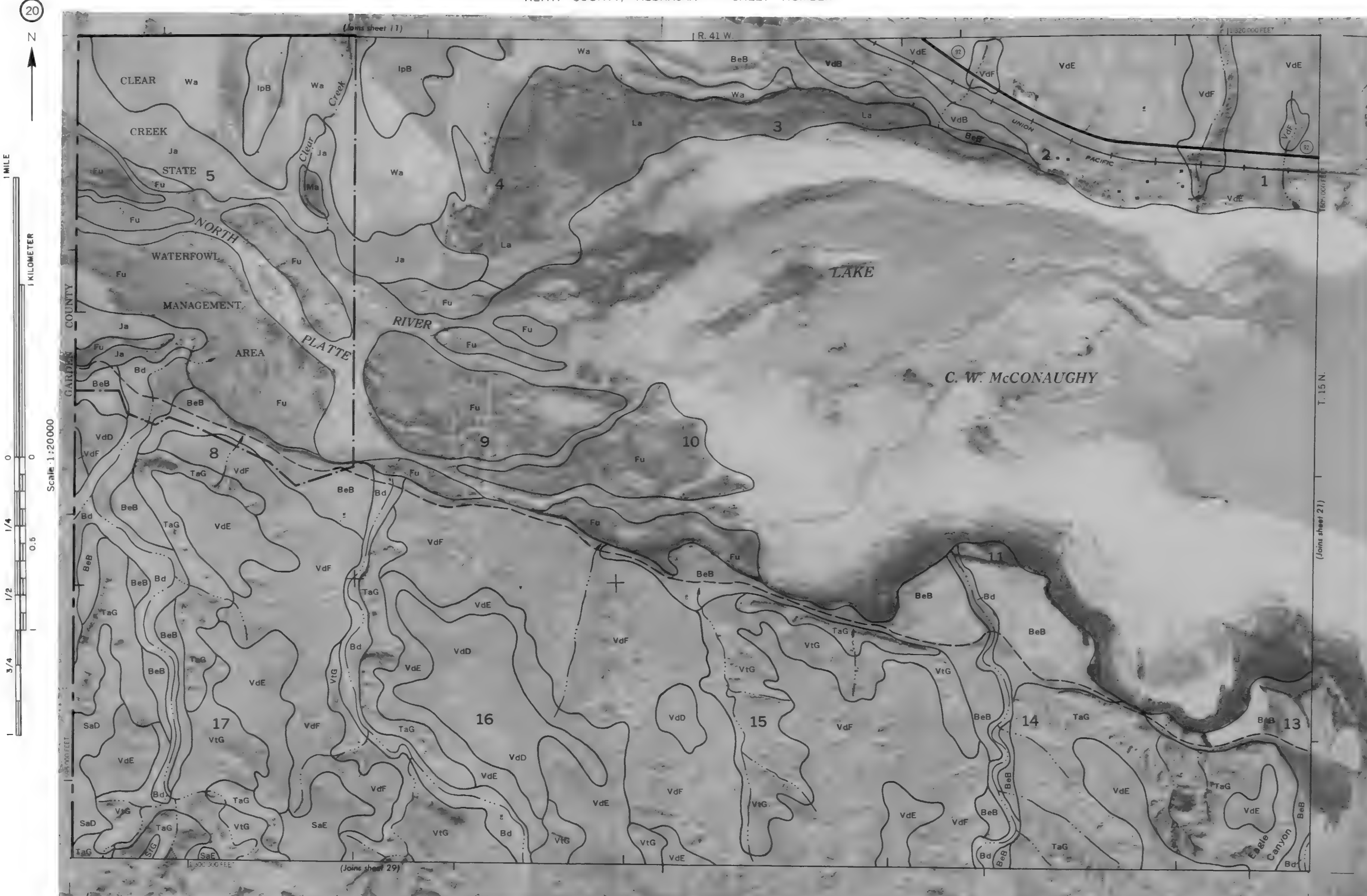

15
N
(Joins sheet 5)
R. 38 W.
1 395 000 FEET
620 000 FEET
T. 16 N.
(Joins sheet 14)
(Joins sheet 16)
(Joins sheet 24)
610 000 FEET
1 415 000 FEET
Whitetail Creek
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
1
0
0.5
1
20
21
22
23
24
25
26
27
28
29
32
33
34
35
36
VdB
VdD
VdE
VdF
IpB
Cu
Cz
Me


16
N
1 MILE
1 KILOMETER
Scale 1:20000
R. 38 W.
R. 37 W.
(Joins sheet 6)
(Joins sheet 16)
(Joins sheet 17)
(Joins sheet 25)
T. 16 N.
19
20
21
22
24
25
27
28
29
30
31
32
33
34
36
VdF
VdD
VdE
VdB
IpB

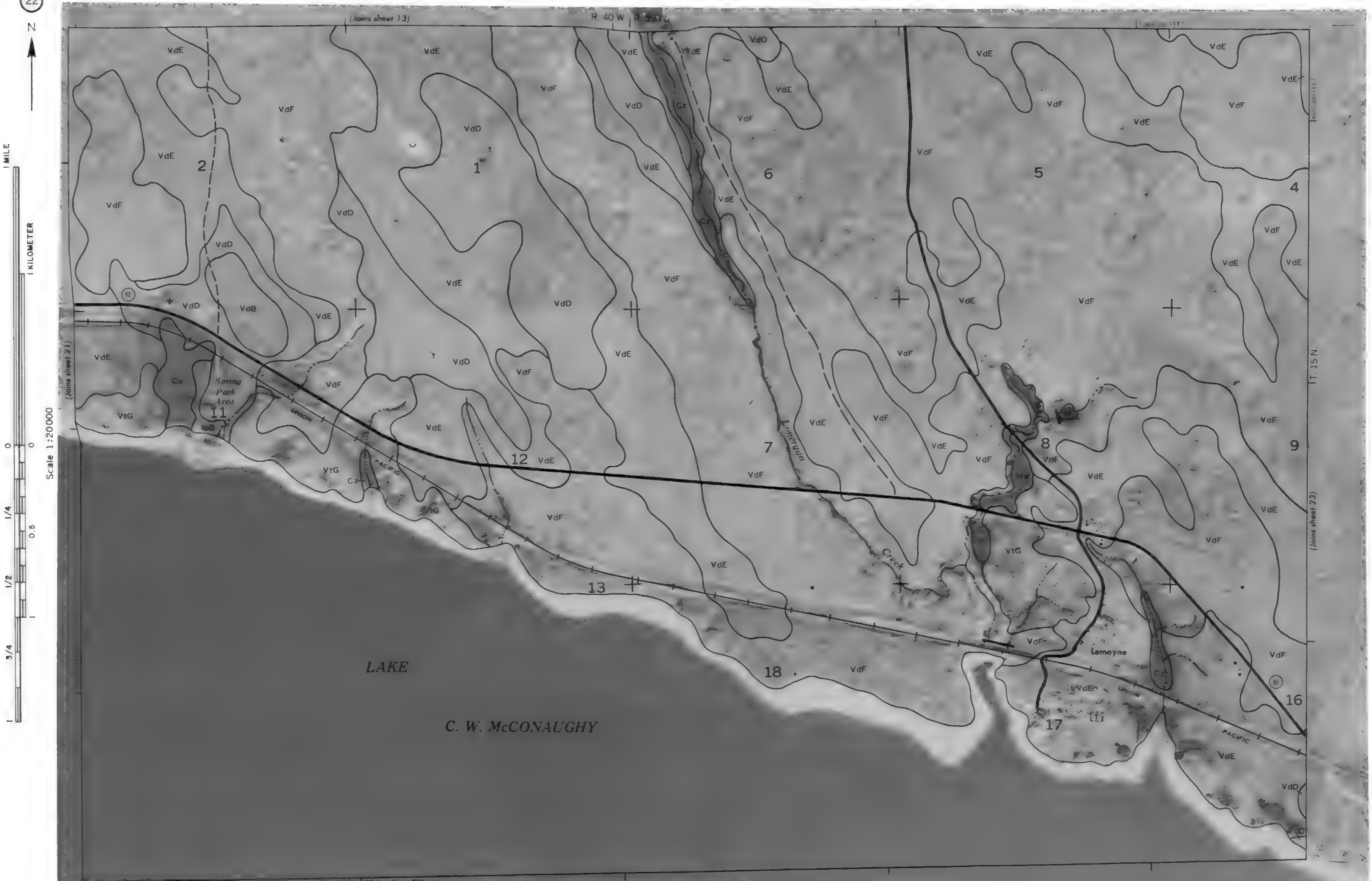

R. 37 W.
R. 36 W.
1 445 000 FEET
(Joins sheet 7)
(Joins sheet 16)
(Joins sheet 18)
(Joins sheet 26)
T. 16 N.
1 460 000 FEET
605 000 FEET
17
N
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
1
0.5
23
24
19
20
21
26
25
30
29
28
35
36
31
32
33
VdF
VdD
VdE
IpB


(Joins sheet 8)
R. 36 W.
R. 35 W.
1 465 000 FEET
(Joins sheet 17)
(Joins sheet 19)
T. 16 N.
(Joins sheet 27)
605 000 FEET
N
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
1
0
0.5
1
21
22
23
24
19
28
27
26
25
30
33
34
35
36
31
VdF
VdE
VdD
IpB

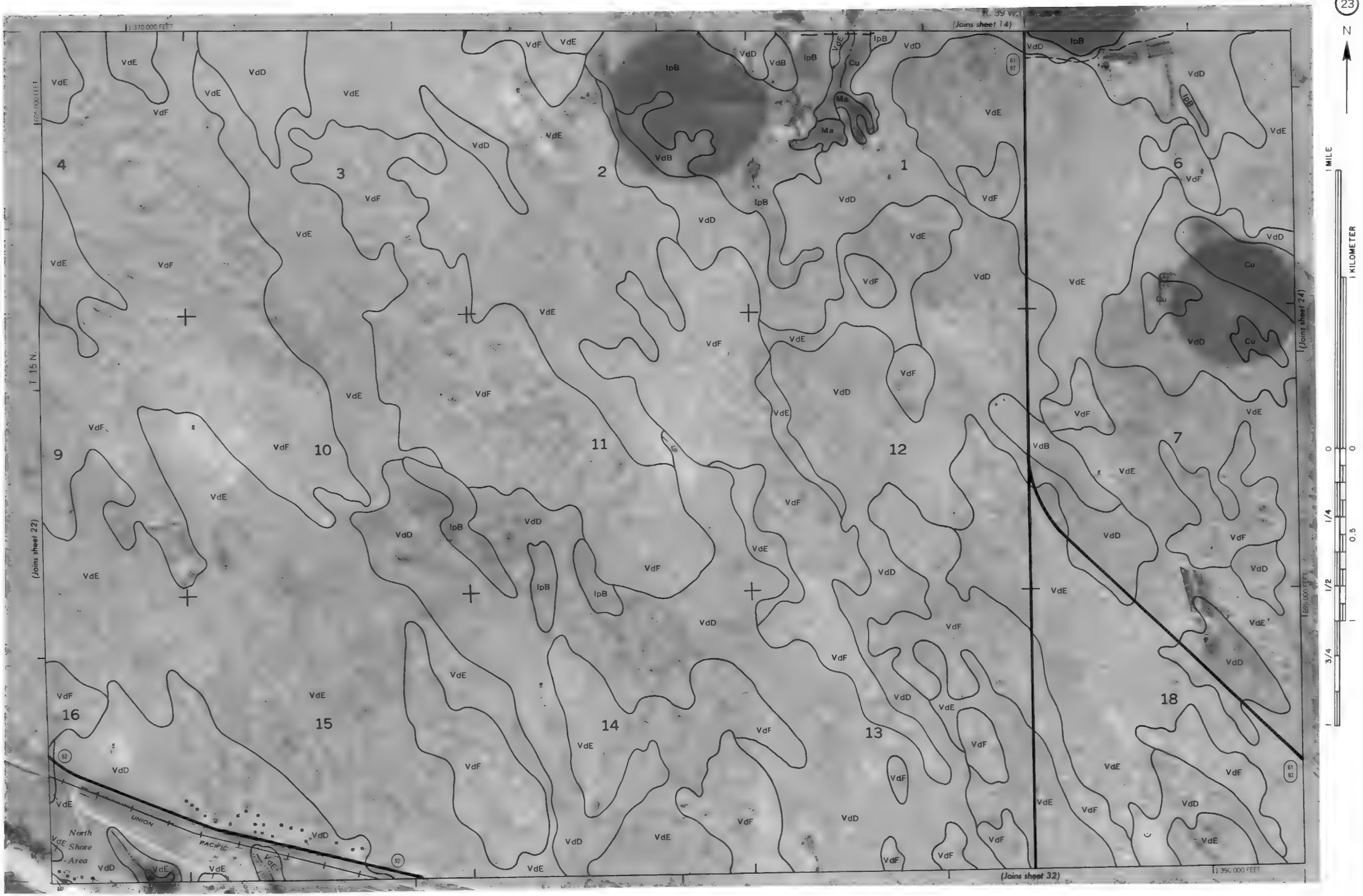

19
N
R. 35 W.
1 490 000 FEET
(Joins sheet 9)
(Joins sheet 18)
(Joins inset A, sheet 10)
(Joins sheet 28)
T. 16 N.
615 000 FEET
605 000 FEET
1 510 000 FEET
1 MILE
1 KILOMETER
0
1/4
1/2
3/4
0.5
Scale 1:20000
20
21
22
23
24
29
28
27
26
25
32
33
34
35
36
VdE
VdF
VdD
VdB
IpB

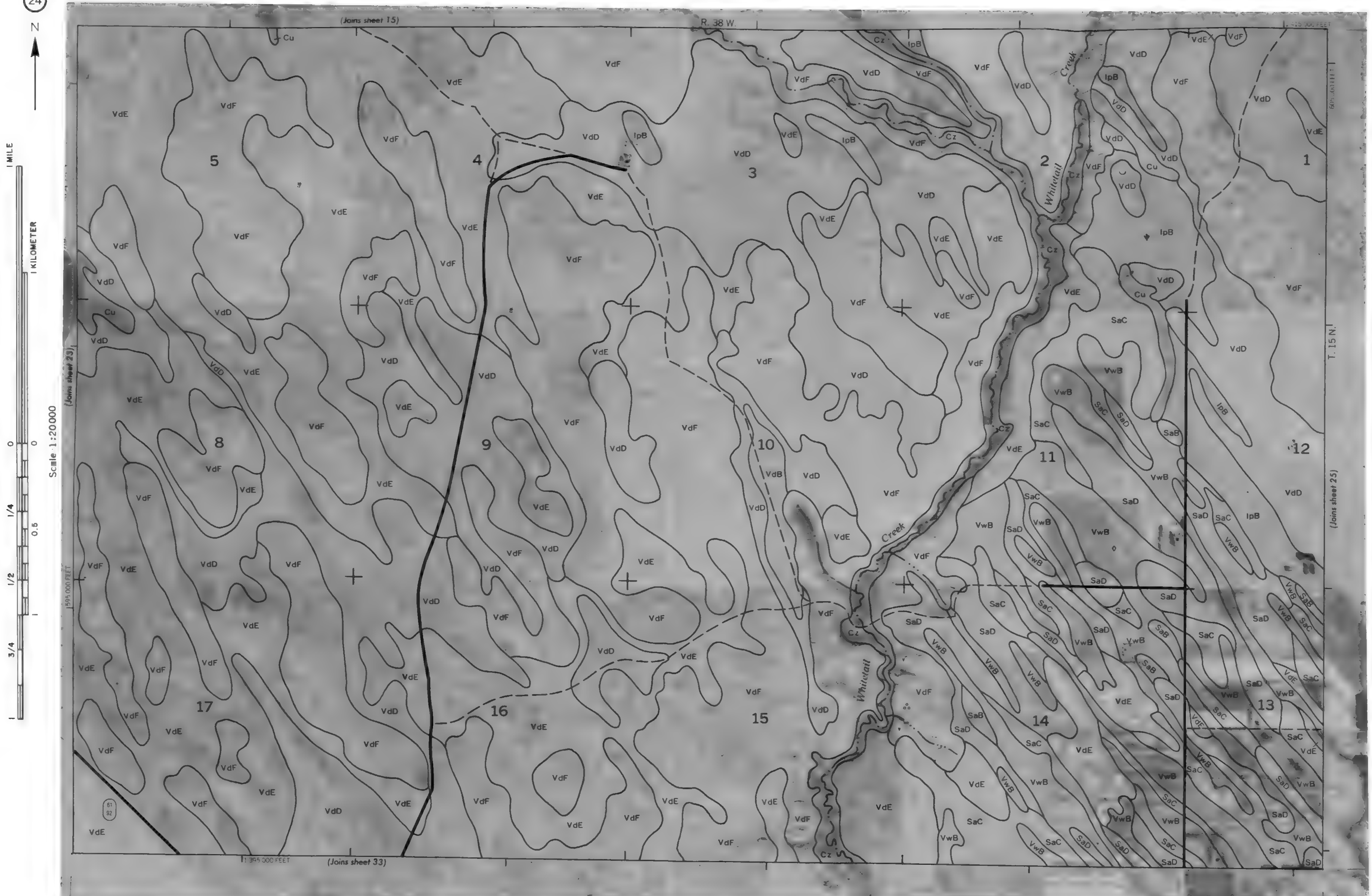

20
N
1 MILE
1 KILOMETER
Scale 1:20000
(Joins sheet 11)
R. 41 W.
T. 15 N.
(Joins sheet 21)
(Joins sheet 29)
GARDEN COUNTY
CLEAR CREEK STATE WATERFOWL MANAGEMENT AREA
Clear Creek
NORTH PLATTE RIVER
LAKE C. W. McCONAUGHY
UNION PACIFIC
Eagle Canyon
92
1
2
3
4
5
8
9
10
11
13
14
15
16
17
Wa
IpB
Ja
Fu
Ma
La
BeB
VdB
VdE
VdF
VdD
Bd
TaG
VtG
SaD
SaE
StG

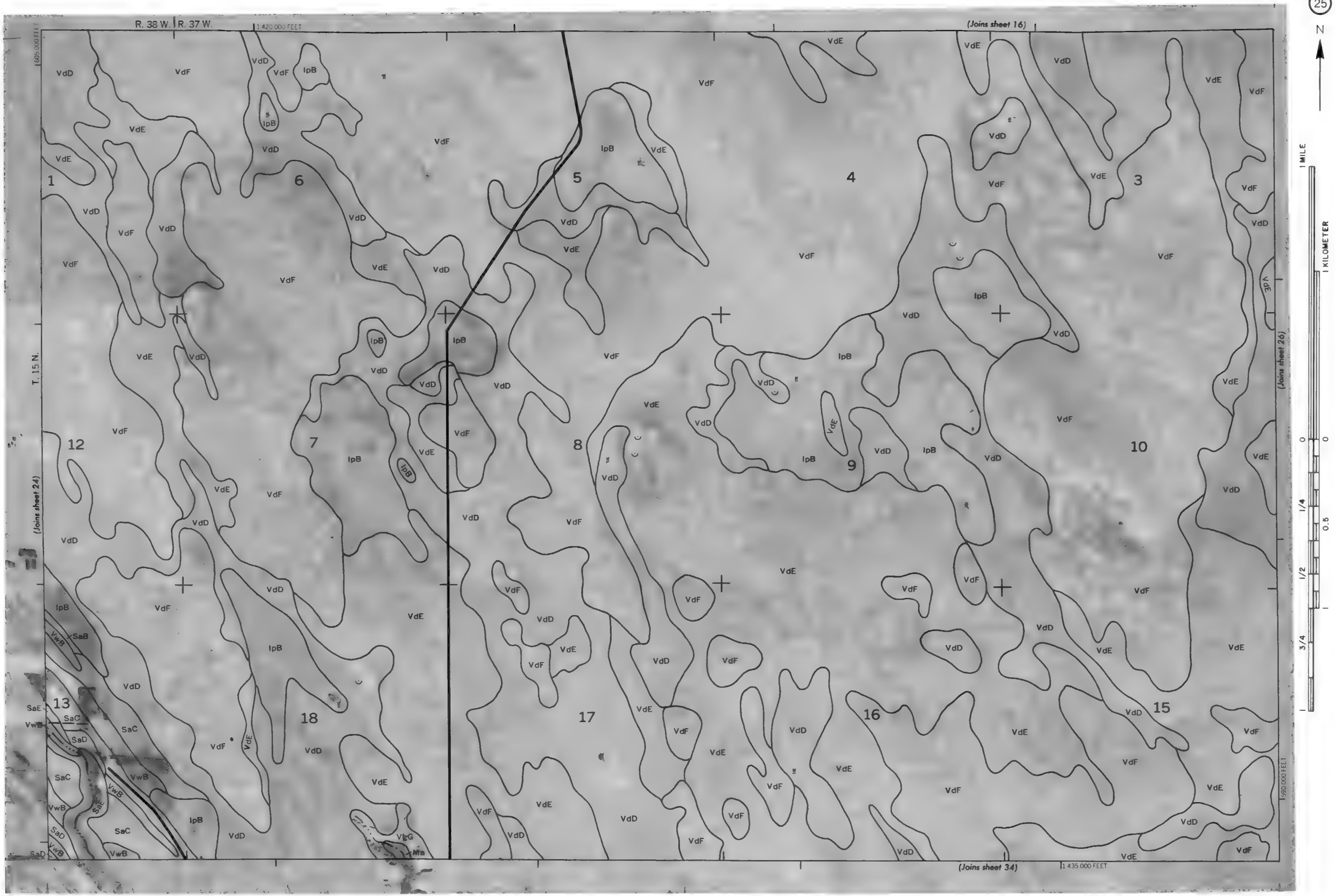

21
N
(Joins sheet 12)
(Joins sheet 20)
(Joins sheet 22)
(Joins sheet 30)
R. 41 W. R. 40 W.
T. 15 N.
1 325 000 FEET
1 340 000 FEET
LAKE
C. W. McCONAUGHY
UNION PACIFIC
Belmar
Cedar Vue Area
Otter Creek Area
Sand Creek Area
Otter Creek
Sand Creek
Eagle Canyon
VdE
VdF
VtG
Cu
BeB
Bd
TaG
SaE
BtB
1
3
4
5
6
8
9
10
13
17
18
1 MILE
1 KILOMETER
Scale 1:20000

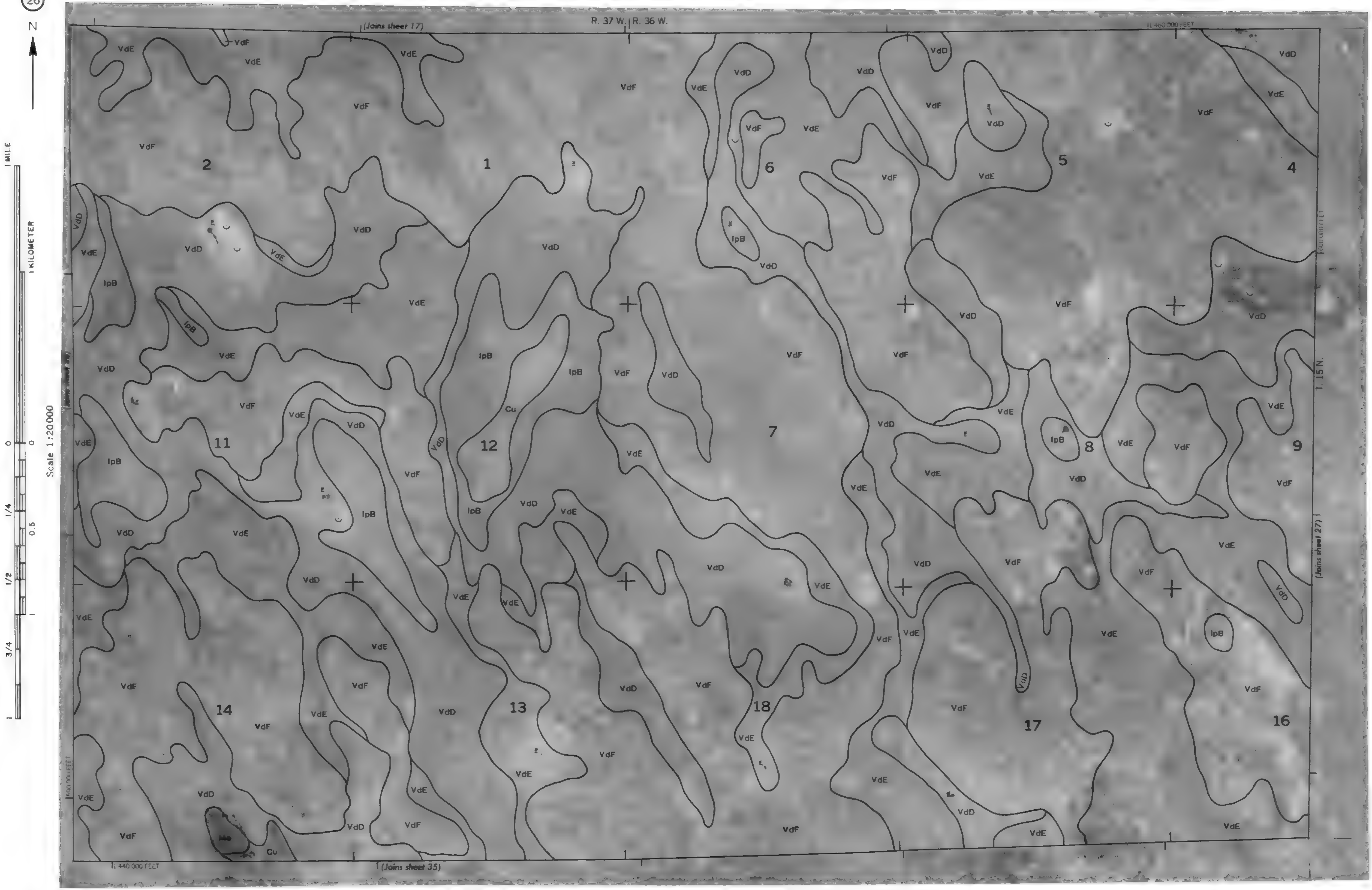

22
N
1 MILE
1 KILOMETER
Scale 1:20000
(Joins sheet 13)
(Joins sheet 21)
(Joins sheet 23)
R. 40 W.
T. 15 N.
LAKE
C. W. McCONAUGHY
Spring Park Area
Lemoyne
Lonergan Creek
UNION PACIFIC
VdE
VdF
VdD
VdB
Cu
VtG
Cz
Ma
1
2
4
5
6
7
8
9
11
12
13
16
17
18

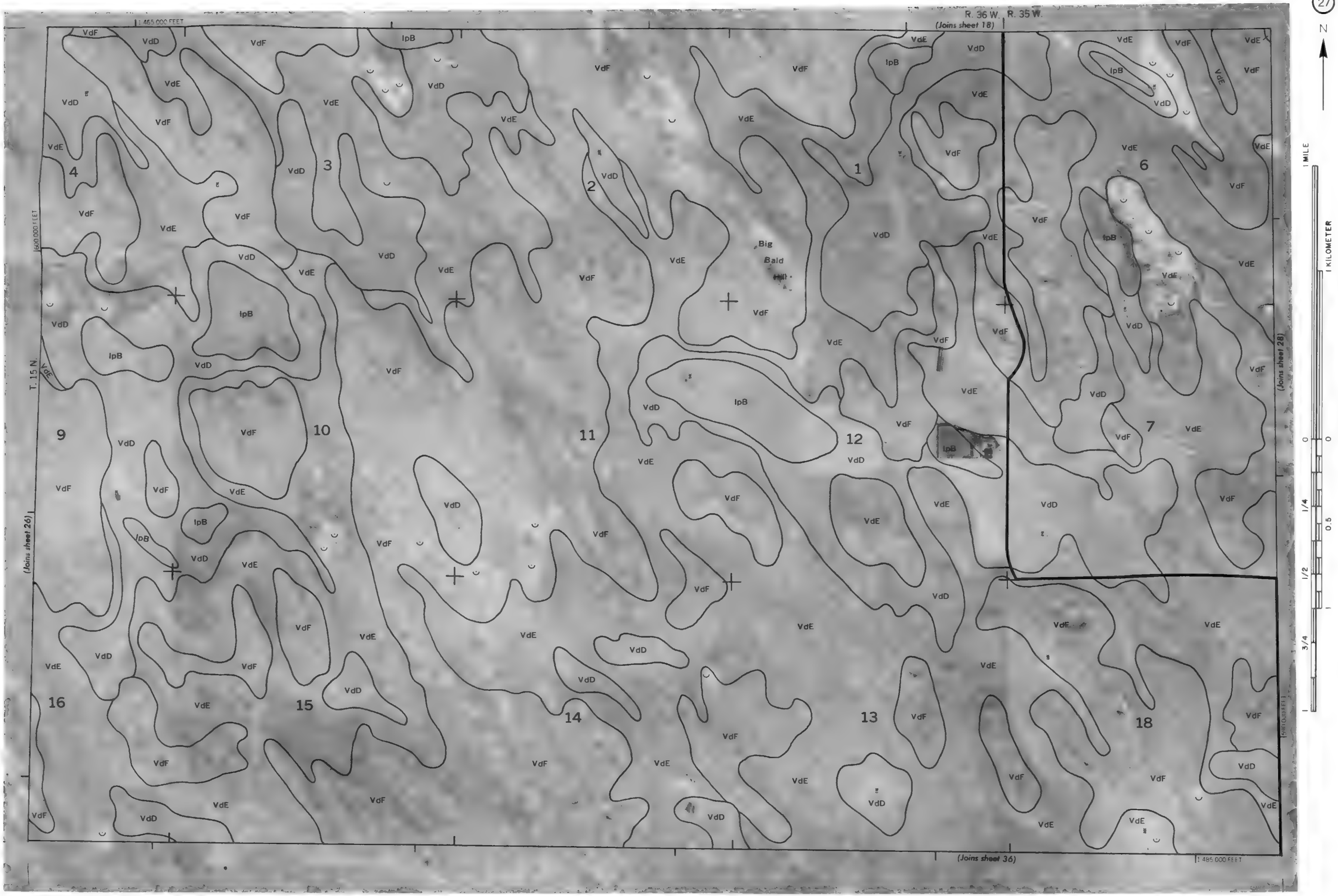
KEITH COUNTY, NEBRASKA — SHEET NUMBER 23

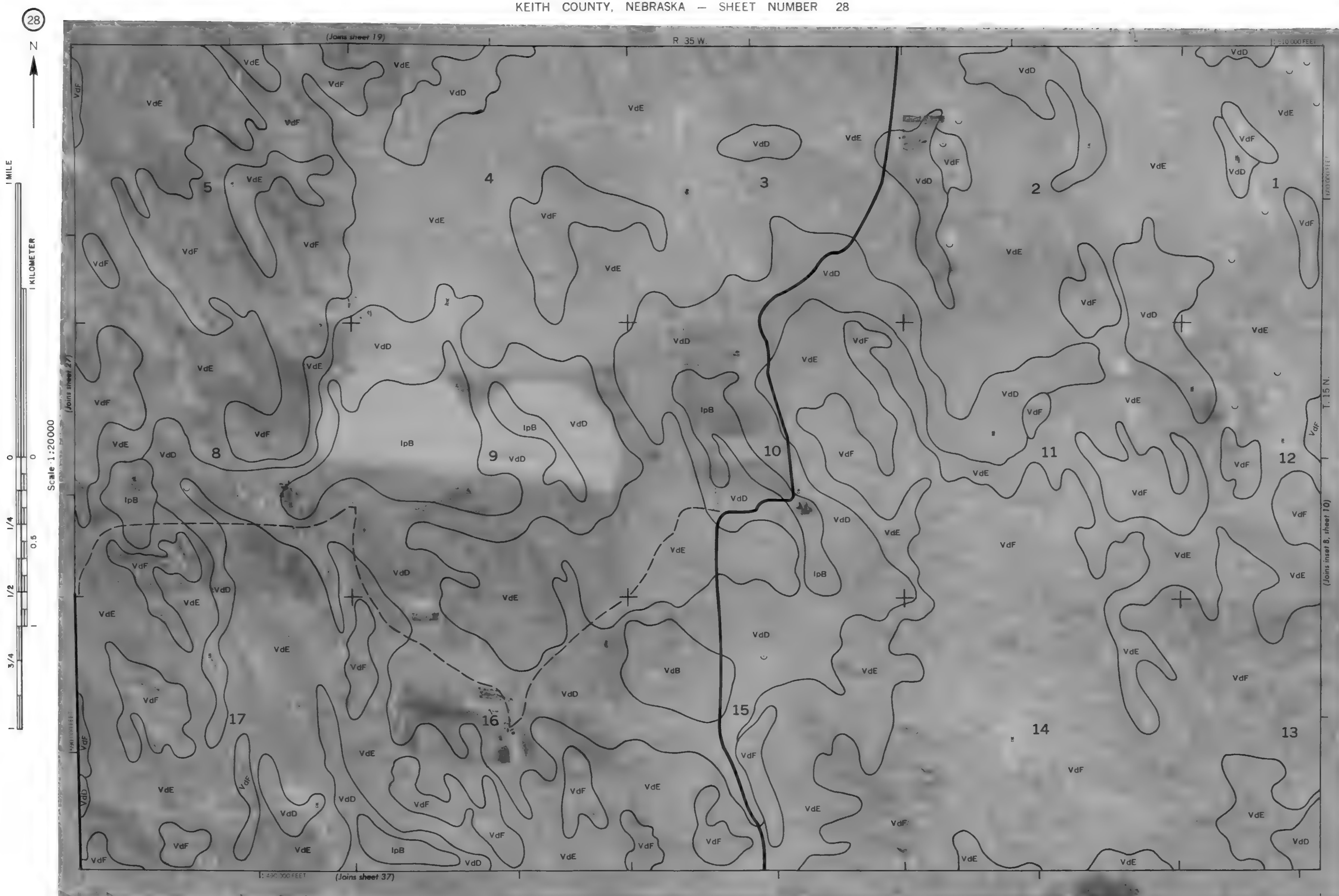


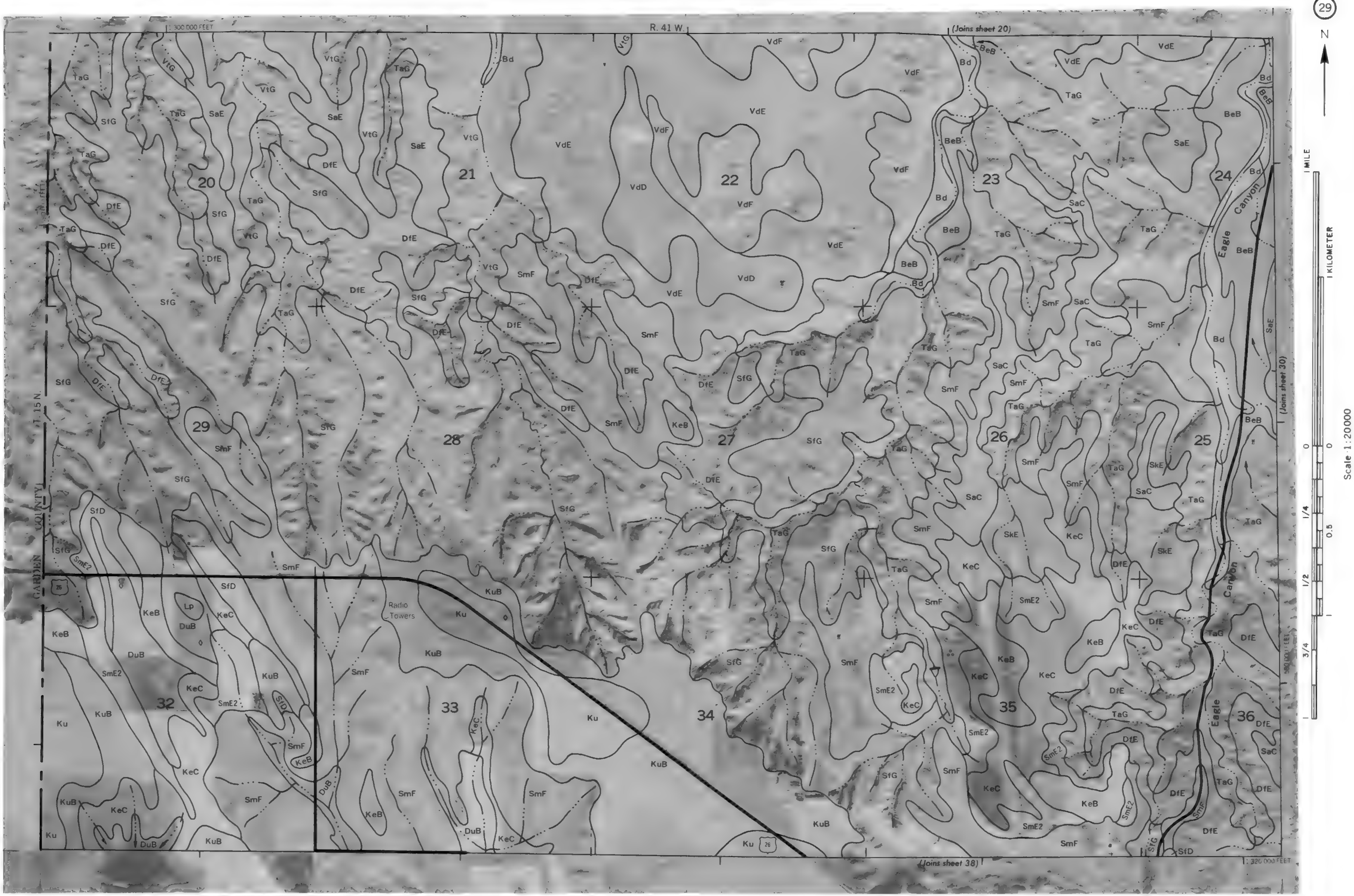

N
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
1
0
0.5
1
(Joins sheet 15)
R. 38 W.
(Joins sheet 23)
(Joins sheet 25)
(Joins sheet 33)
T. 15 N.
Whitetail Creek
1
2
3
4
5
8
9
10
11
12
13
14
15
16
17
VdD
VdE
VdF
IpB
Cu
Cz
SaB
SaC
SaD
VwB


25
N
R. 38 W.
R. 37 W.
1 420 000 FEET
(Joins sheet 16)
(Joins sheet 24)
(Joins sheet 26)
(Joins sheet 34)
1 435 000 FEET
T. 15 N.
1 MILE
1 KILOMETER
0
1/4
1/2
3/4
1
0.5
Scale 1:20000
1
3
4
5
6
7
8
9
10
12
13
15
16
17
18
VdD
VdE
VdF
IpB
SaB
SaC
SaD
SaE
VwB
VhG
Ma


N
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
1
0
0.5
1
(Joins sheet 17)
R. 37 W. | R. 36 W.
1 460 000 FEET
T. 15 N.
(Joins sheet 27)
(Joins sheet 35)
1 440 000 FEET
1
2
4
5
6
7
8
9
11
12
13
14
16
17
18
VdD
VdE
VdF
IpB
Cu
Me


27
R. 36 W.
R. 35 W.
(Joins sheet 18)
(Joins sheet 28)
(Joins sheet 36)
(Joins sheet 26)
T. 15 N.
1 465 000 FEET
1 485 000 FEET
600 000 FEET
Big Bald Hill
N
1 MILE
1 KILOMETER
Scale 1:20 000


28
N
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
1
0
0.5
1
(Joins sheet 19)
R. 35 W.
(Joins sheet 27)
T. 15 N.
(Joins inset 8, sheet 10)
(Joins sheet 37)
1
2
3
4
5
8
9
10
11
12
13
14
15
16
17
VdB
VdD
VdE
VdF
IpB

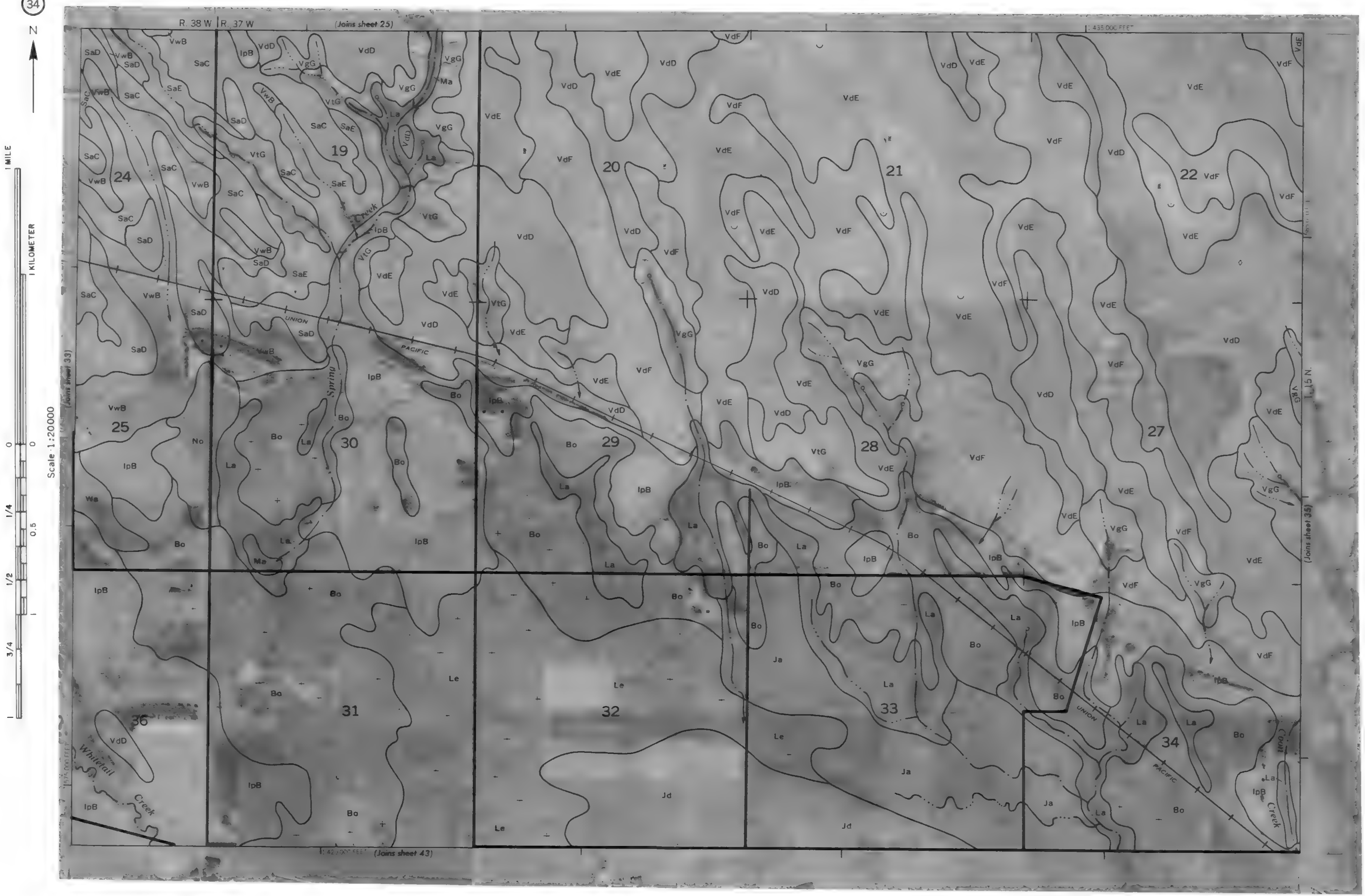

29
N
R. 41 W.
(Joins sheet 20)
(Joins sheet 30)
(Joins sheet 38)
300 000 FEET
320 000 FEET
T. 15 N.
GARDEN COUNTY
Eagle Canyon
Eagle Canyon
Radio Towers
20
21
22
23
24
25
26
27
28
29
32
33
34
35
36
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
1
0
0.5
1


N
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
1
0.5
R. 41 W.
R. 40 W.
(Joins sheet 21)
(Joins sheet 29)
(Joins sheet 31)
(Joins sheet 39)
T. 15 N.
LAKE
C. W. McCONAUGHY
Coyote
Canyon
19
20
21
22
24
25
27
28
29
30
31
32
33
34
36
SaE
SaC
TaG
BeB
BtB
Bd
VtG
SfG
SmF
DfE
DsG
DuB
KeB
KeC
KuB

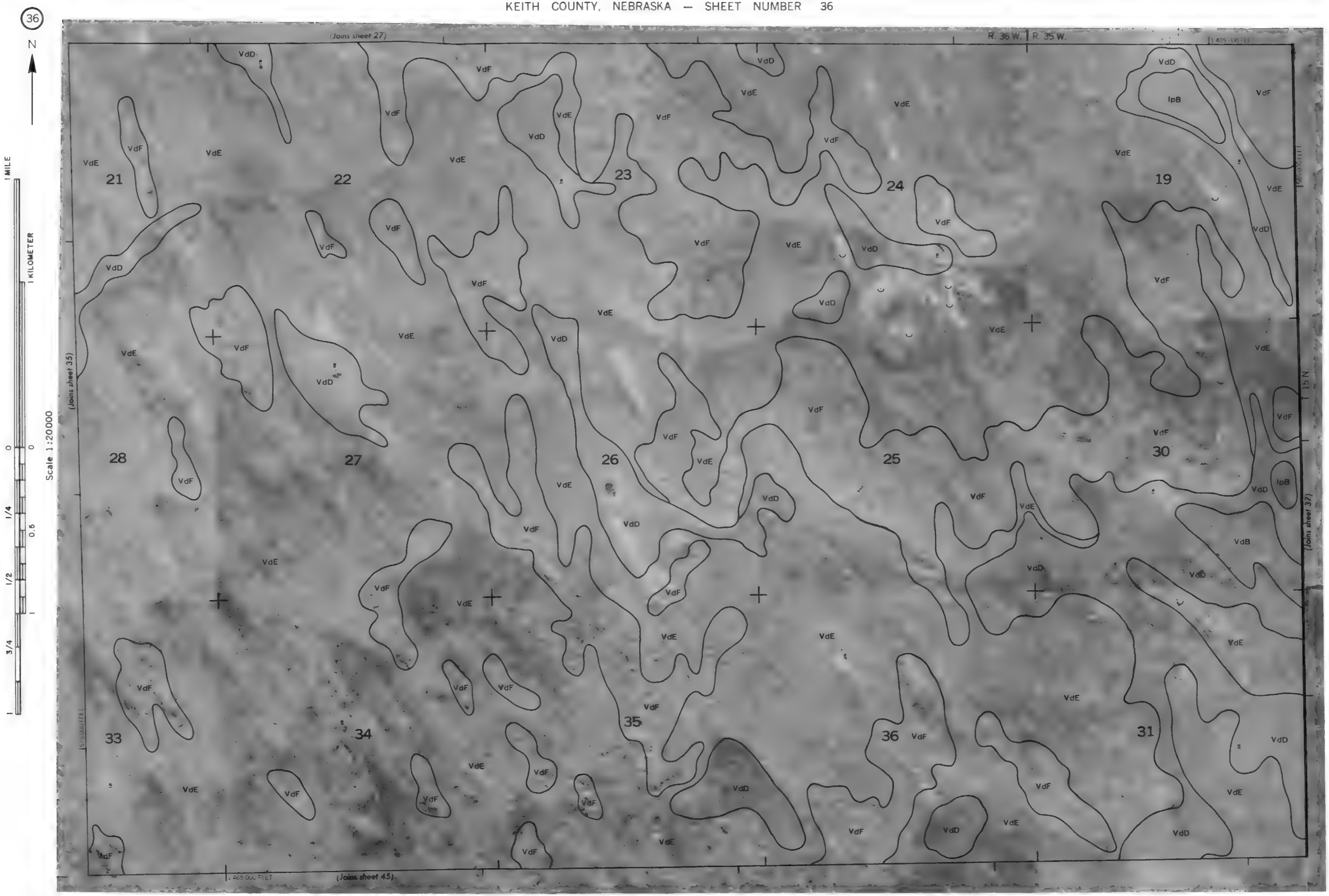

31
N
LAKE C. W. McCONAUGHY
(Joins sheet 22)
(Joins sheet 30)
(Joins sheet 32)
(Joins sheet 40)
T. 15 N.
1 365 000 FEET
580 000 FEET
Lake McConaughy Landing Strip
Lake View Area
Ash Canyon
Camp
Berry Gulch
25
26
30
31
32
35
36
VtG
SaE
VdE
VdD
VdF
SaC
VwB
BeB
TaG
Bd
DuB
SmF
SfG
SaD
DsG
1 MILE
1 KILOMETER
Scale 1:20000

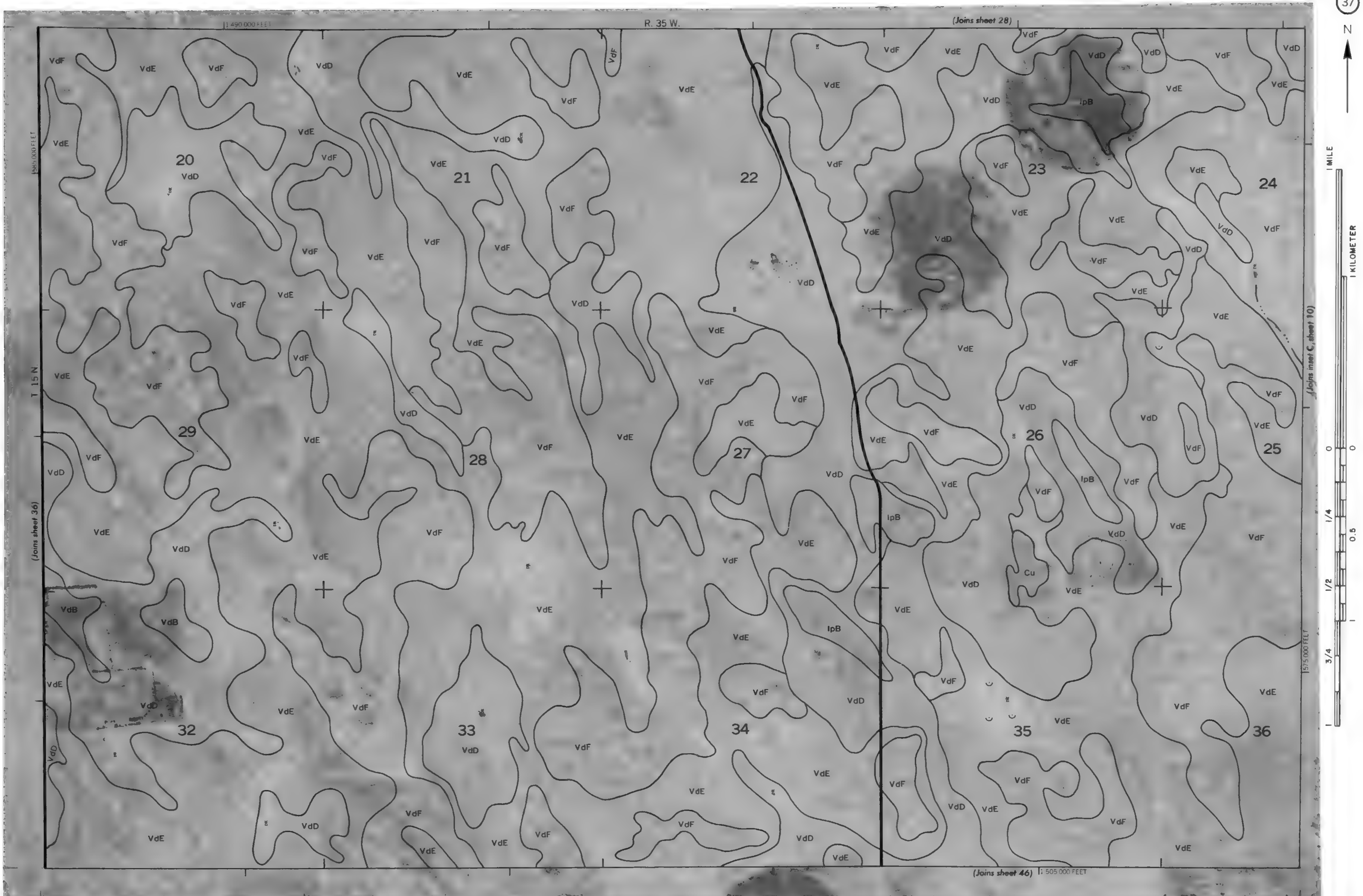

32
N
1 MILE
1 KILOMETER
0
1/4
1/2
3/4
1
0
0.5
1
Scale 1:20000
(Joins sheet 23)
R. 39 W.
R. 38 W.
North Shore Area
Sandy Beach Area
UNION
PACIFIC
21
22
23
24
19
VdD
VdE
VdF
Arthur Bay Area
Arthur Bay
T. 15 N.
(Joins sheet 33)
LAKE
C. W. McCONAUGHY
1 370 000 FEET
(Joins sheet 41)


33
N
R. 38 W.
(Joins sheet 24)
(Joins sheet 34)
(Joins sheet 42)
(Joins sheet 32)
T. 15 N.
1 395 000 FEET
590 000 FEET
1 415 000 FEET
1 MILE
1 KILOMETER
Scale 1:20000
Martin
UNION PACIFIC
Martin Bay Area
Martin Bay
water
Whitetail Creek
LAKE C. W. McCONAUGHY
GEORGE P. KINGSLEY DAM
LAKE OGALLALA
LAKE OGALLALA STATE RECREATION AREA
Camp Ground
20
21
22
23
24
25
26
27
28
29
34
35
36
VdE
VdF
VdD
SaC
SaD
VwB
IpB
Bo
No
Wa
Cz
Cu
La


N
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
1
0
0.5
1
R. 38 W
R. 37 W
(Joins sheet 25)
(Joins sheet 33)
(Joins sheet 35)
(Joins sheet 43)
T. 15 N.
UNION
PACIFIC
Spring
Creek
Whitetail
Creek
19
20
21
22
24
25
27
28
29
30
31
32
33
34
36


35
N
R. 37 W. | R. 36 W.
(Joins sheet 26)
(Joins sheet 34)
(Joins sheet 36)
(Joins sheet 44)
T. 15 N.
1 440 000 FEET
1 460 000 FEET
585 000 FEET
575 000 FEET
19
20
21
23
24
25
26
28
29
30
31
32
33
35
36
Coon Creek
VdD
VdE
VdF
VgG
VtG
Ma
Cu
La
Bo
IpB
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
1
0.5


36
N
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
1
0
0.5
1
(Joins sheet 27)
R. 36 W.
R. 35 W.
(Joins sheet 35)
(Joins sheet 37)
(Joins sheet 45)
T. 15 N.
21
22
23
24
19
28
27
26
25
30
33
34
35
36
31
VdD
VdE
VdF
VdB
IpB


37
N
R. 35 W.
(Joins sheet 28)
(Joins sheet 36)
(Joins sheet 46)
(Joins inset C, sheet 90)
T. 15 N.
1 490 000 FEET
505 000 FEET
575 000 FEET
20
21
22
23
24
25
26
27
28
29
32
33
34
35
36
VdF
VdE
VdD
VdB
IpB
Cu
1 MILE
1 KILOMETER
0
1/4
1/2
3/4
1
0.5
Scale 1:20000


38
N
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
1
0
0.5
1
(Joins sheet 29)
R. 41 W.
T. 14 N.
(Joins sheet 39)
(Joins sheet 47)
DEUEL COUNTY
1
2
3
4
5
8
9
10
11
12
13
14
15
16
17
Ku
KuB
KeB
KeC
DuB
DfE
Lp
SfD
SfG
SmF
SmE2
26

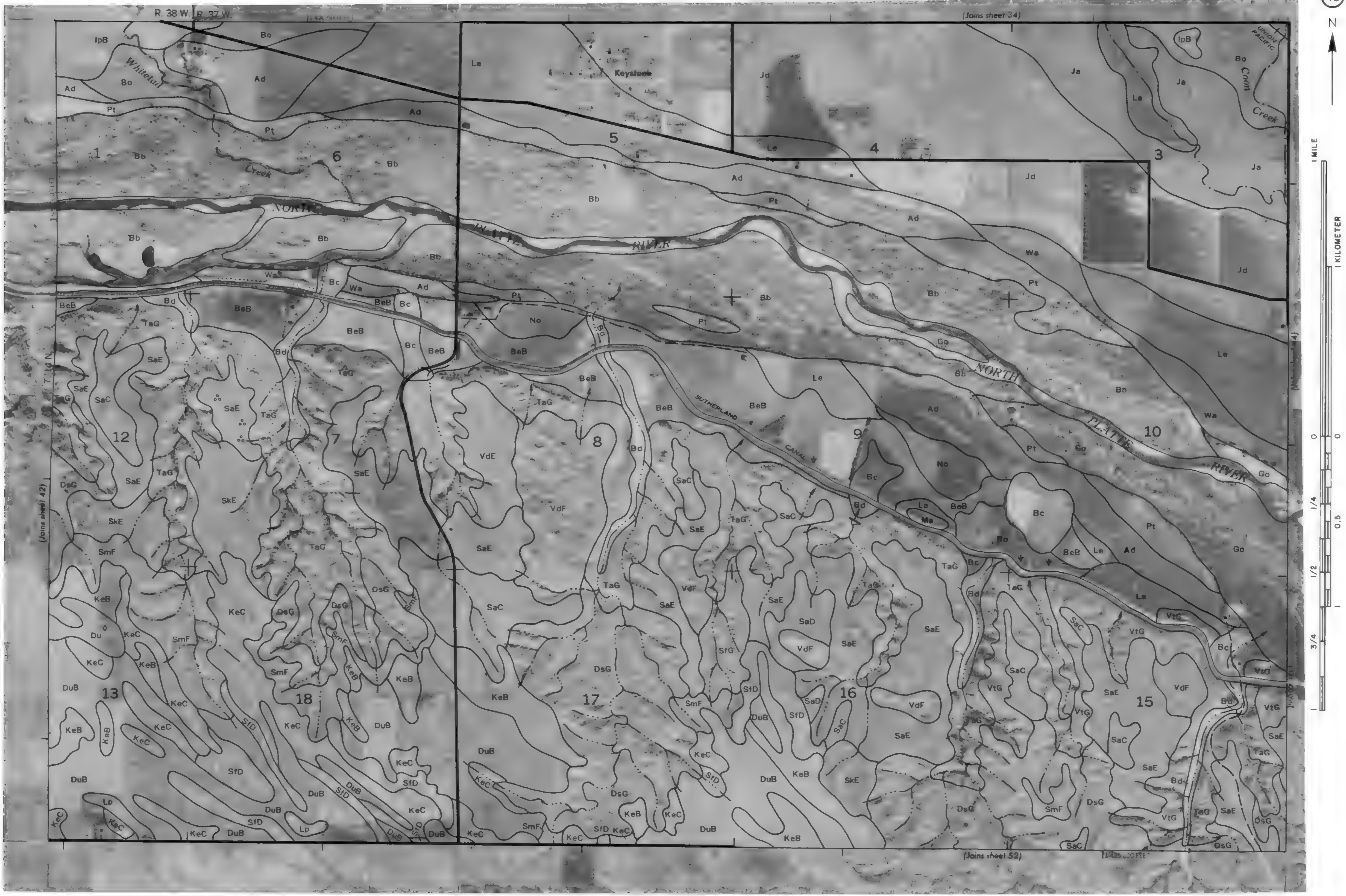

39
R. 41 W.
R. 40 W.
(Joins sheet 30)
(Joins sheet 38)
(Joins sheet 40)
(Joins sheet 48)
T. 14 N.
Eagle Canyon
Coyote Canyon
N
1 MILE
1 KILOMETER
Scale 1:20000


40
N
1 MILE
1 KILOMETER
Scale 1:20000
(Joins sheet 31)
(Joins sheet 39)
(Joins sheet 41)
(Joins sheet 49)
R. 40 W. | R. 39 W.
T. 14 N.
LAKE
C. W.
McCONAUGHY
Ash Camp Canyon
Berry Gulch
O'Brien Canyon
Kelly Canyon
Ogallala Gulch

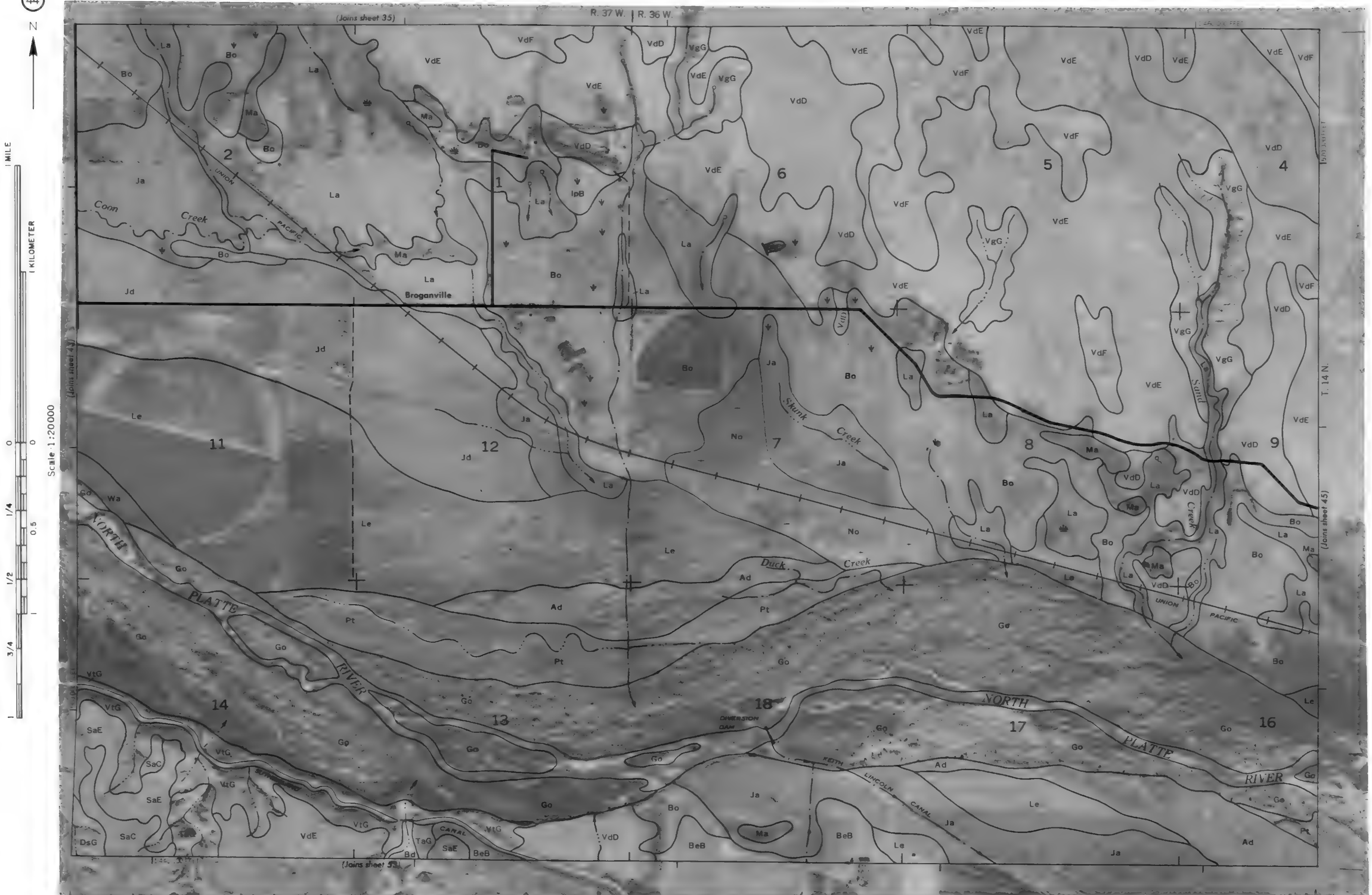

41
N
LAKE C. W. McCONAUGHY
(Joins sheet 32)
R. 39 W.
R. 38 W.
(Joins sheet 40)
(Joins sheet 42)
(Joins sheet 50)
T. 14 N.
Ogallala Beach Area
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
1
0.5
VtG
VdE
VdD
SaD
SaC
SaB
VwB
SfG
KeC
KeB
DuB
SmF
SfD
SmE2
Lp
DfE
TaG
2
3
4
7
9
10
11
12
13
14
15
16
18

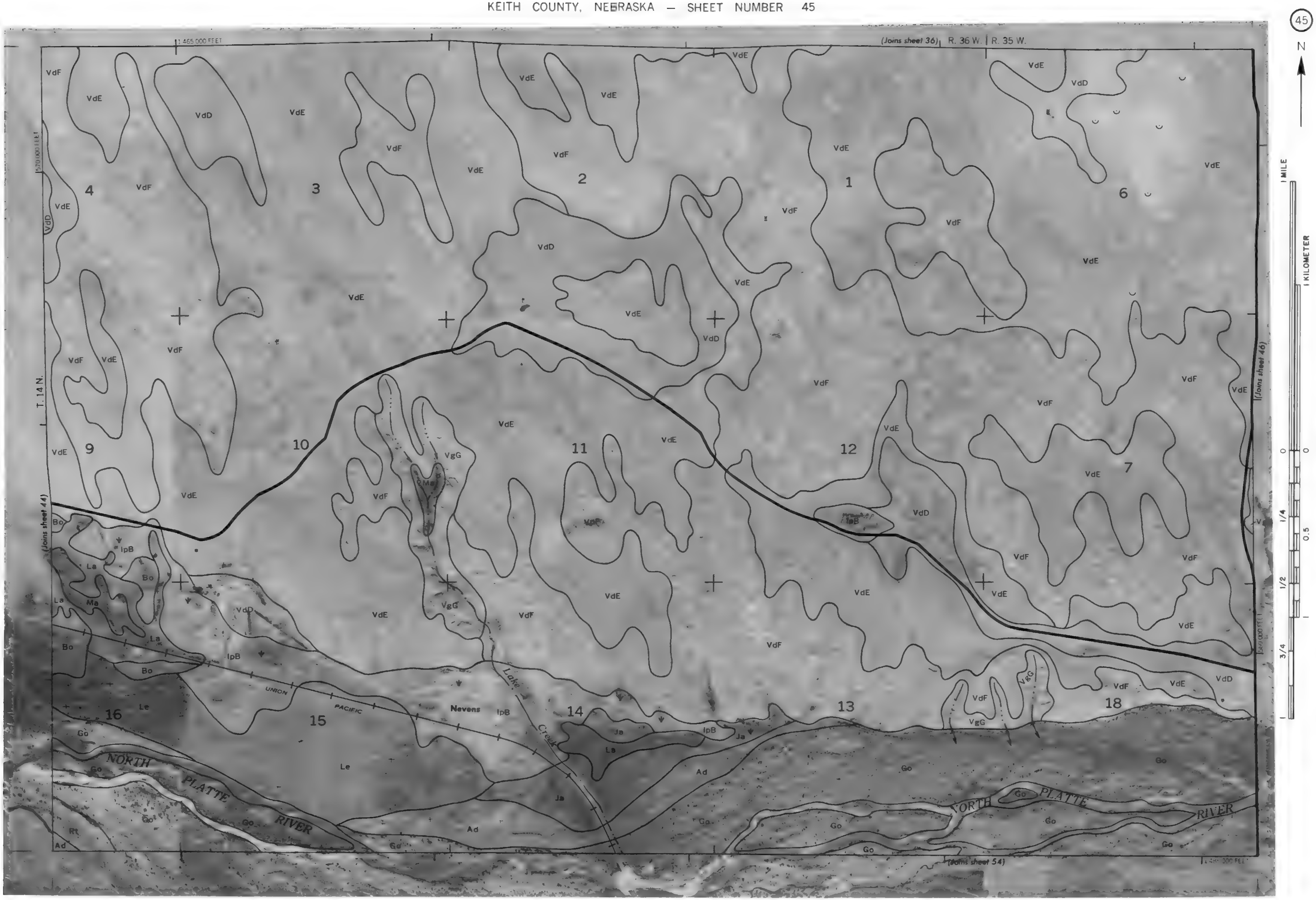

N
1 MILE
1 KILOMETER
Scale 1:20000
(Joins sheet 33)
LAKE C. W. McCONAUGHY
GEORGE P. KINGSLEY DAM
LAKE OGALLALA STATE RECREATION AREA
LAKE OGALLALA
KEYSTONE DIVERSION DAM
NORTH PLATTE
SUTHERLAND CANAL
Cedar Point Camp
(Joins sheet 41)
(Joins sheet 43)
(Joins sheet 51)

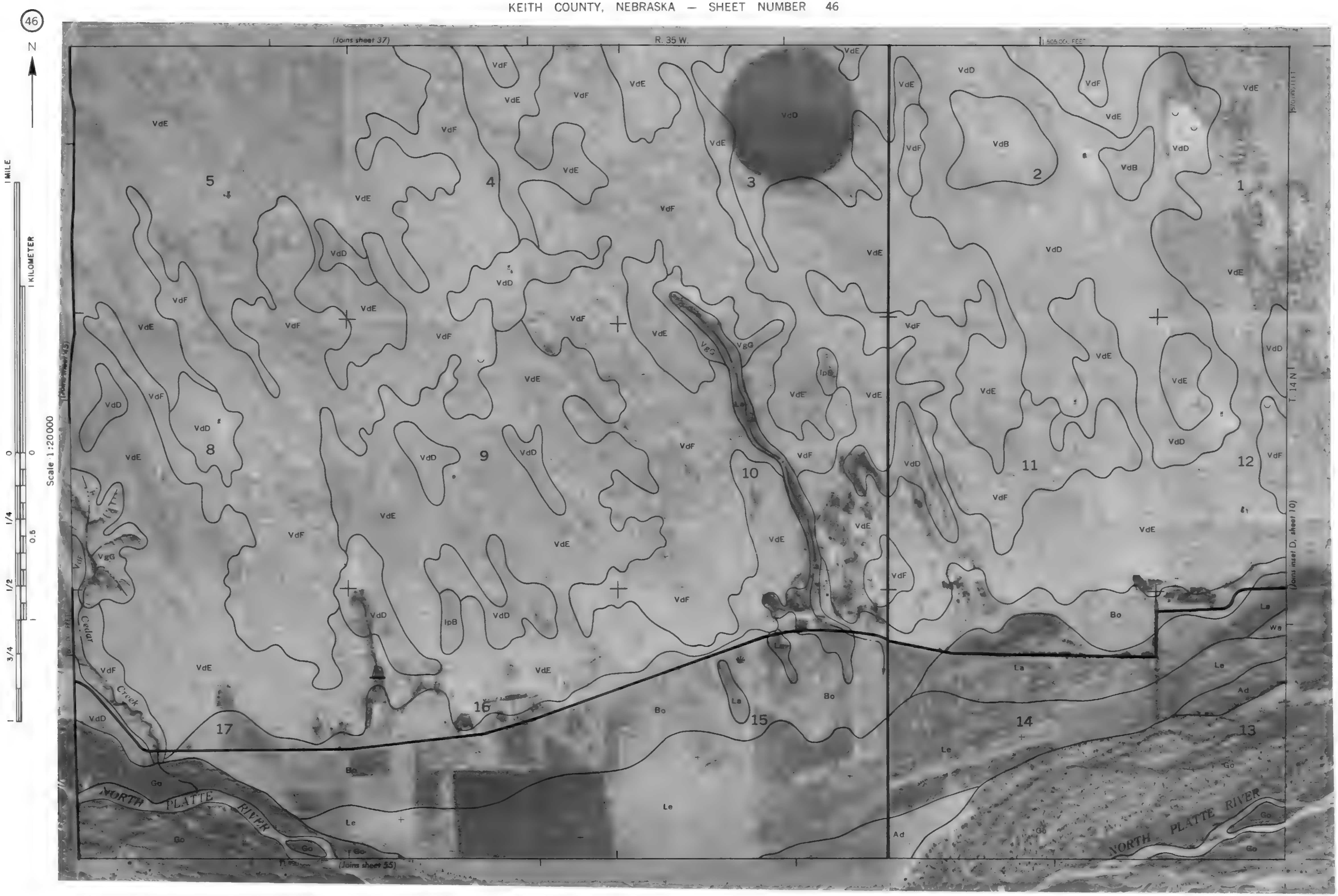
43

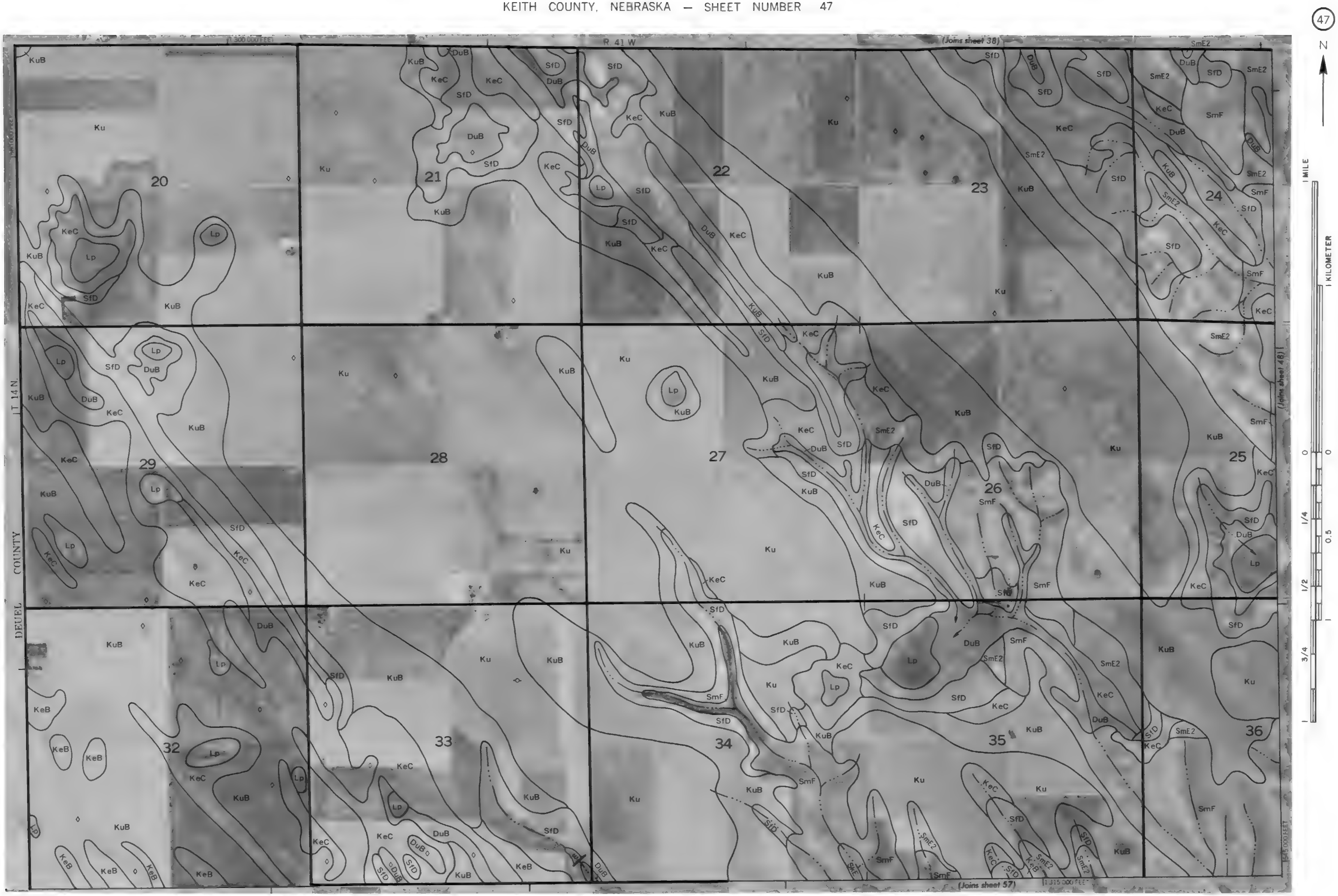

R. 38 W.
R. 37 W.
(Joins sheet 34)
(Joins sheet 42)
(Joins sheet 52)
Keystone
Whitetail Creek
NORTH PLATTE RIVER
SUTHERLAND CANAL
Coon Creek
UNION PACIFIC
N
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
1
0.5
1
3
4
5
6
7
8
9
10
12
13
15
16
17
18

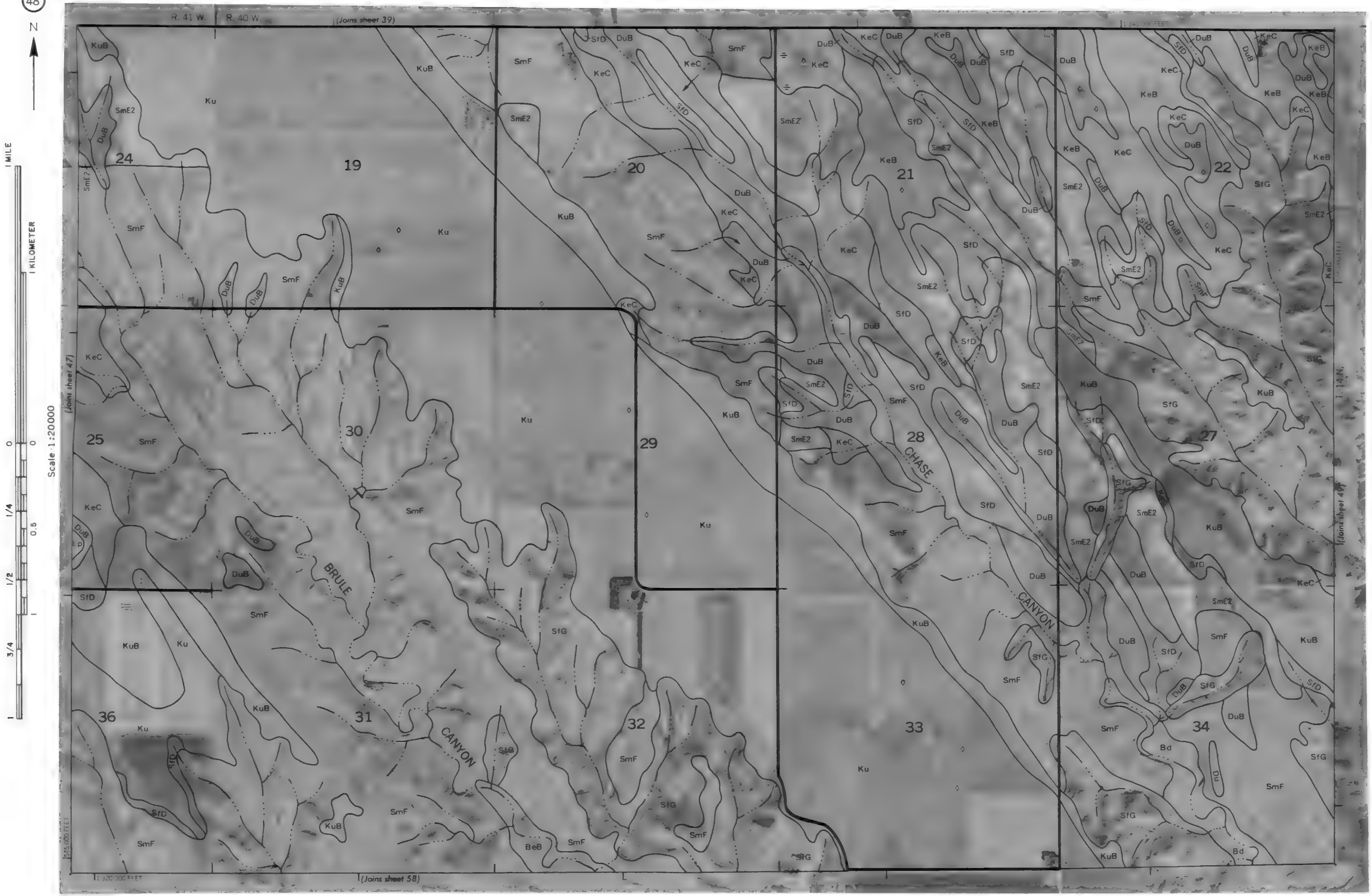
44


N
1 MILE
1 KILOMETER
Scale 1:20000
(Joins sheet 35)
R. 37 W.
R. 36 W.
T. 14 N.
(Joins sheet 43)
(Joins sheet 45)
(Joins sheet 53)
Broganville
Coon Creek
UNION PACIFIC
Skunk Creek
Duck Creek
Sand Creek
NORTH PLATTE RIVER
DIVERSION DAM
KEITH LINCOLN CANAL
CANAL

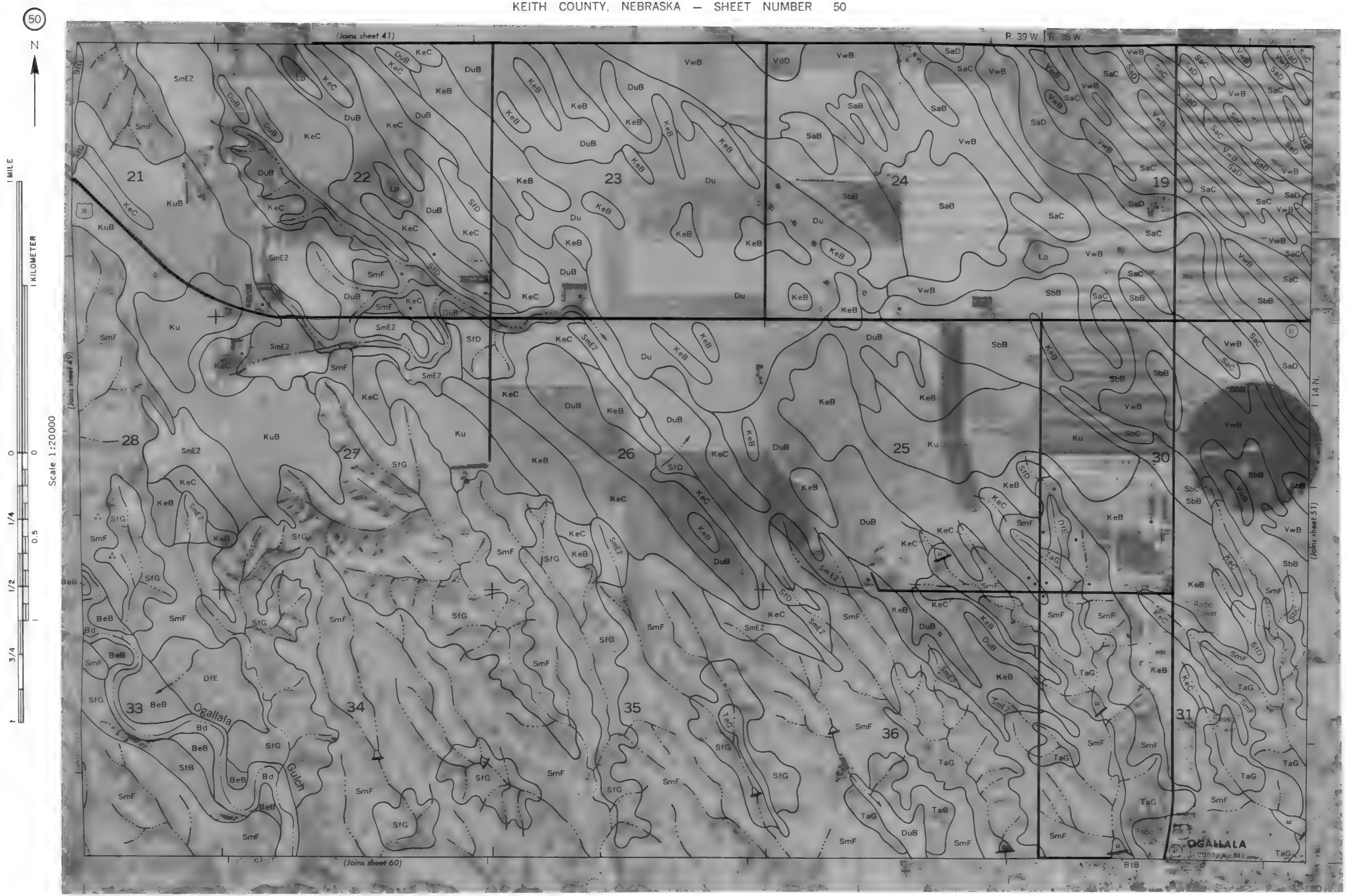

45
N
(Joins sheet 36)
R. 36 W.
R. 35 W.
T. 14 N.
(Joins sheet 44)
(Joins sheet 46)
(Joins sheet 54)
UNION PACIFIC
Nevens
Lake Creek
NORTH PLATTE RIVER
1 MILE
1 KILOMETER
Scale 1:20000

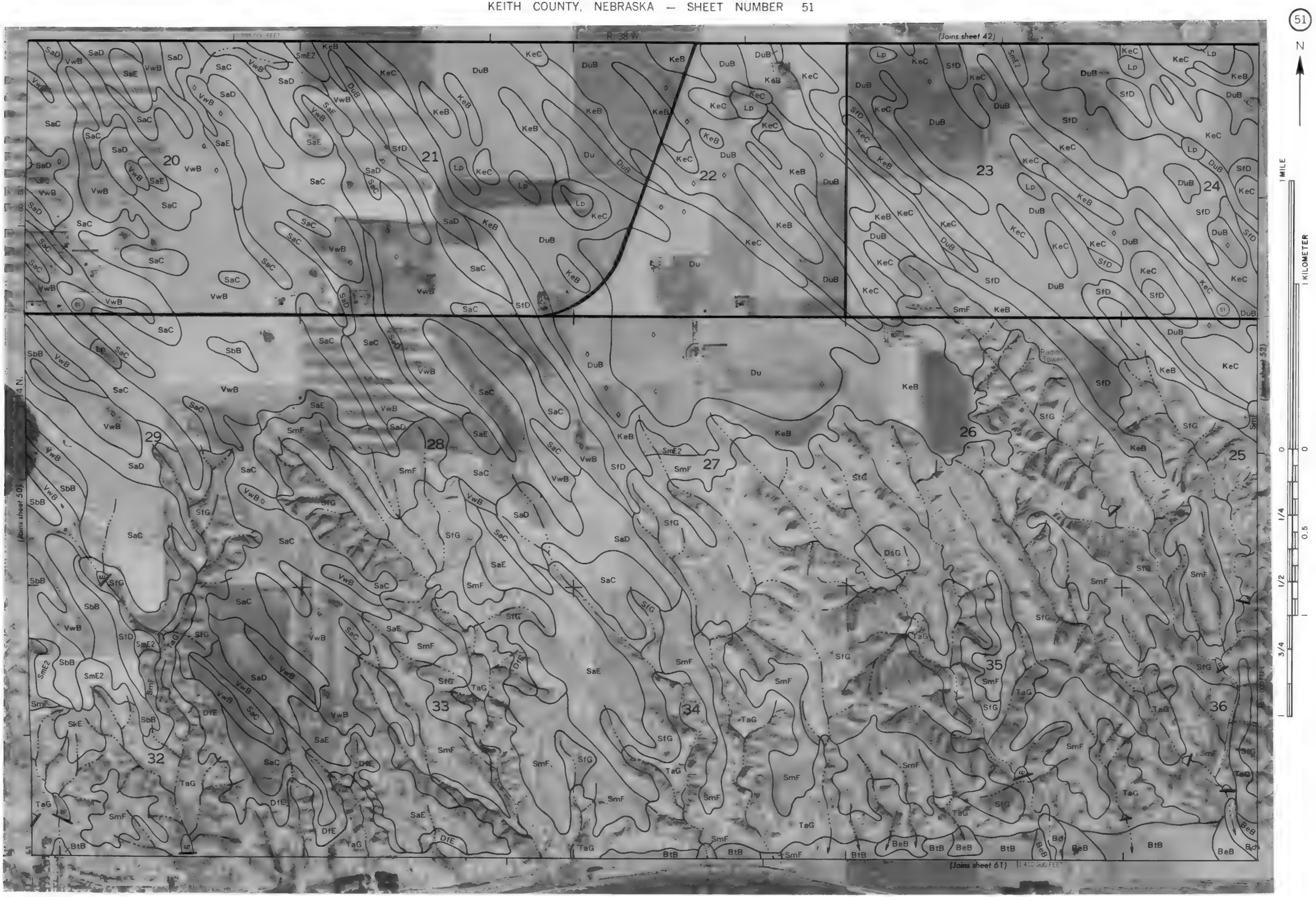

46
N
1 MILE
1 KILOMETER
0
1/4
1/2
3/4
1
0.5
Scale 1:20000
(Joins sheet 37)
R. 35 W.
T. 14 N.
(Joins inset D, sheet 10)
(Joins sheet 55)
NORTH PLATTE RIVER
NORTH PLATTE RIVER
Cedar Creek
1
2
3
4
5
8
9
10
11
12
13
14
15
16
17
VdB
VdD
VdE
VdF
VgG
IpB
Bo
La
Le
Ld
Ad
Wa
Go

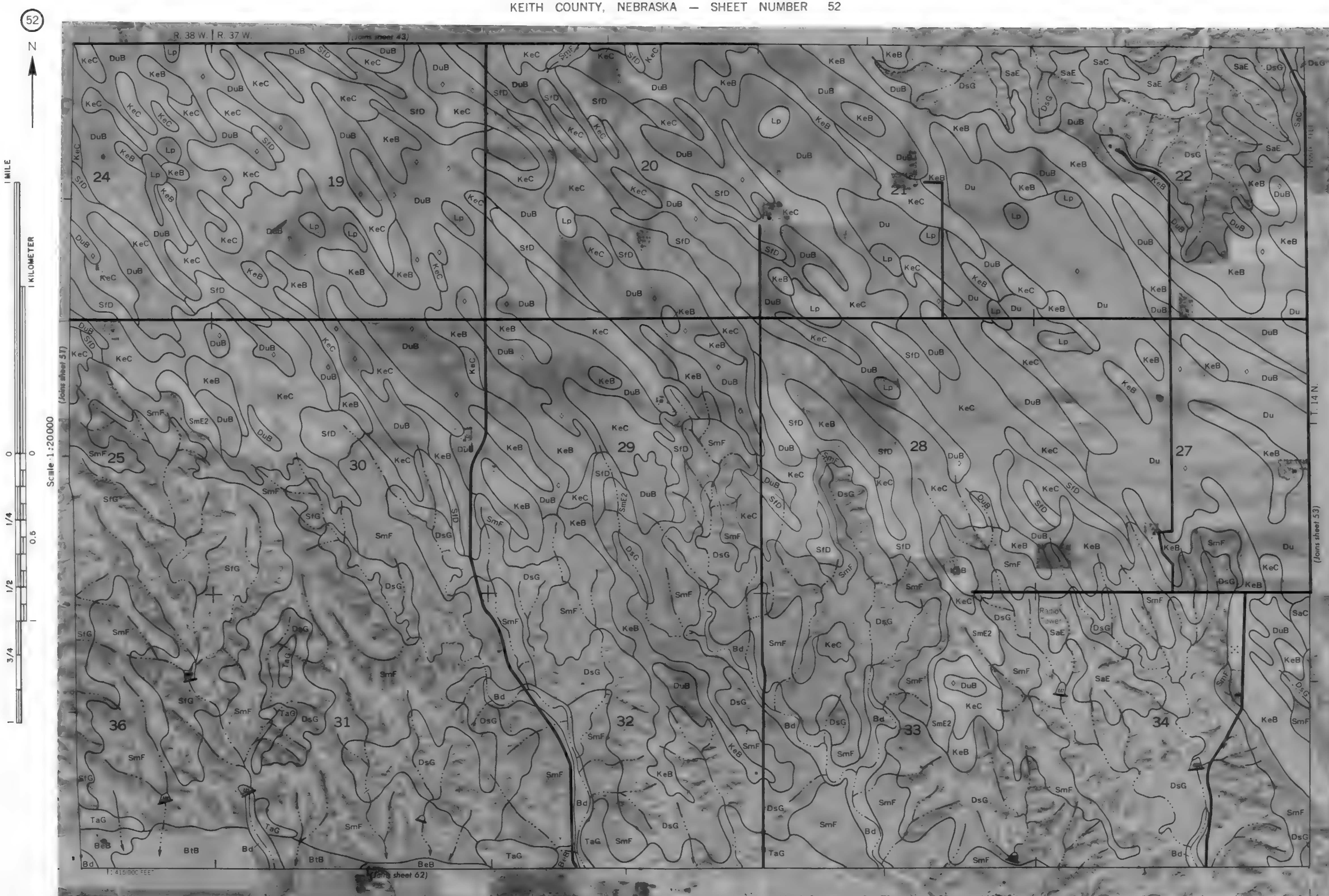

47
N
R 41 W
(Joins sheet 38)
(Joins sheet 48)
(Joins sheet 57)
T 14 N.
DEUEL COUNTY
1 300 000 FEET
1 315 000 FEET
20
21
22
23
24
25
26
27
28
29
32
33
34
35
36
1 MILE
1 KILOMETER
0
1/4
1/2
3/4
0.5
Scale 1:20000

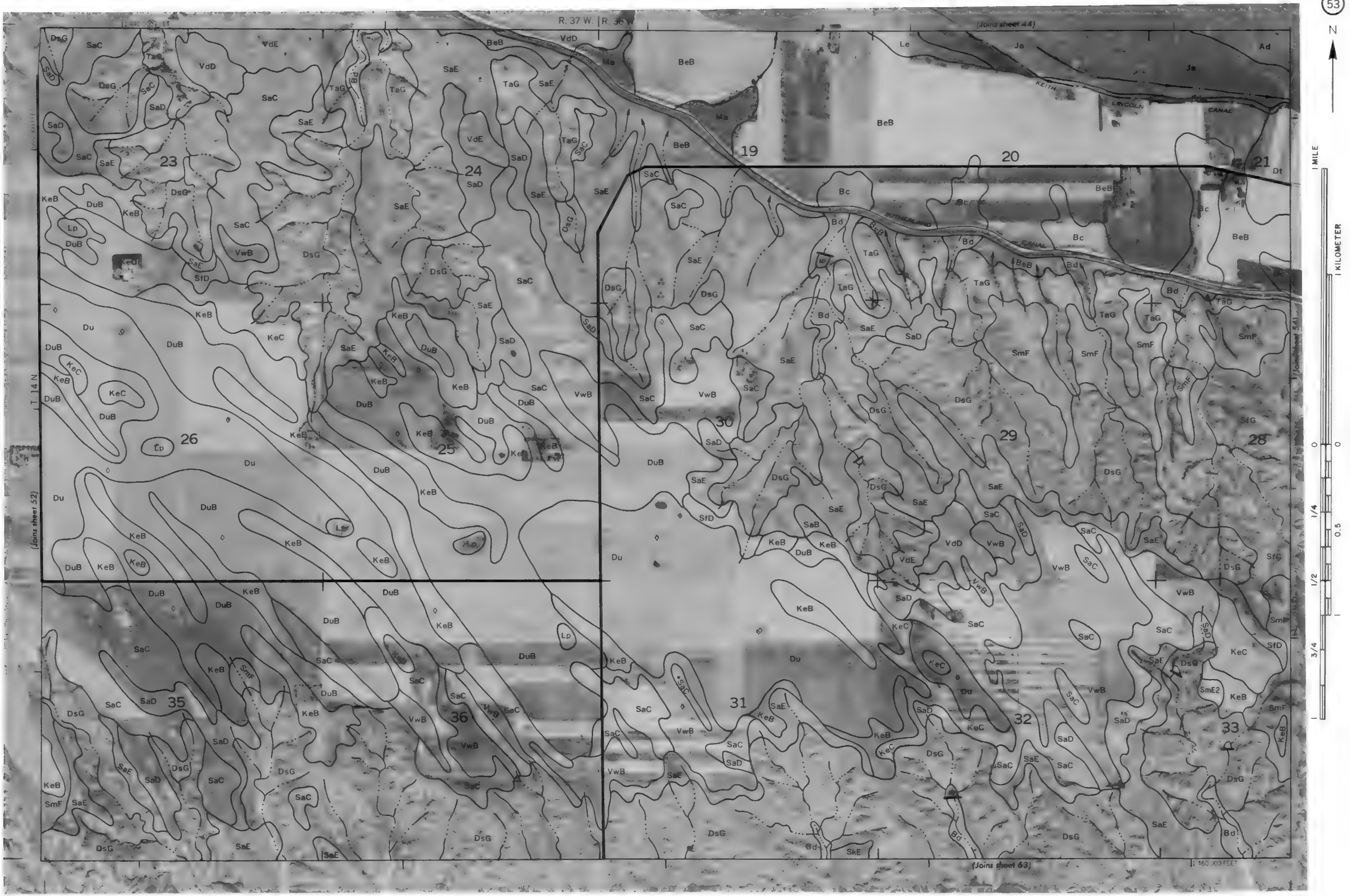

N
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
1
0
0.5
1
R. 41 W.
R. 40 W.
(Joins sheet 39)
(Joins sheet 47)
(Joins sheet 49)
(Joins sheet 58)
T. 14 N.
19
20
21
22
24
25
27
28
29
30
31
32
33
34
36
BRULE CANYON
CHASE CANYON
Ku
KuB
KeB
KeC
DuB
Du
SmF
SmE2
SfD
SfG
Bd
BeB
Lp


49
N
(Joins sheet 40)
(Joins sheet 48)
(Joins sheet 50)
(Joins sheet 59)
R. 40 W.
R. 39 W.
T. 14 N.
1 345 000 FEET
1 365 000 FEET
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
1
0.5
Ogallala
Gulch
19
20
21
23
24
25
26
28
29
30
31
32
33
35
36

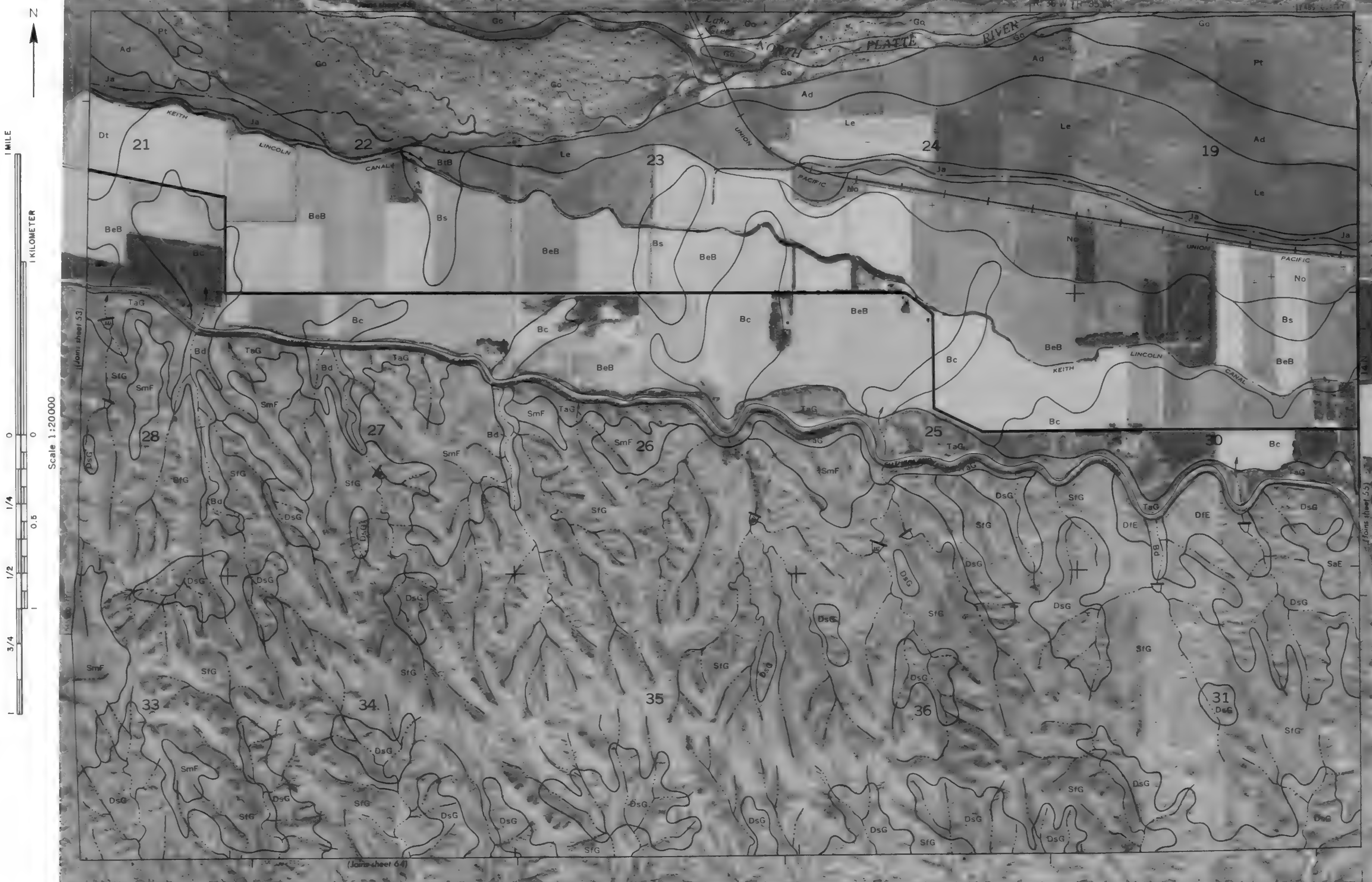

50
N
1 MILE
1 KILOMETER
Scale 1:20000
(Joins sheet 41)
(Joins sheet 49)
(Joins sheet 51)
(Joins sheet 60)
R. 39 W.
R. 38 W.
T. 14 N.
21
22
23
24
19
28
27
26
25
30
33
34
35
36
31
Ogallala
Gulch
Radio Tower
OGALLALA

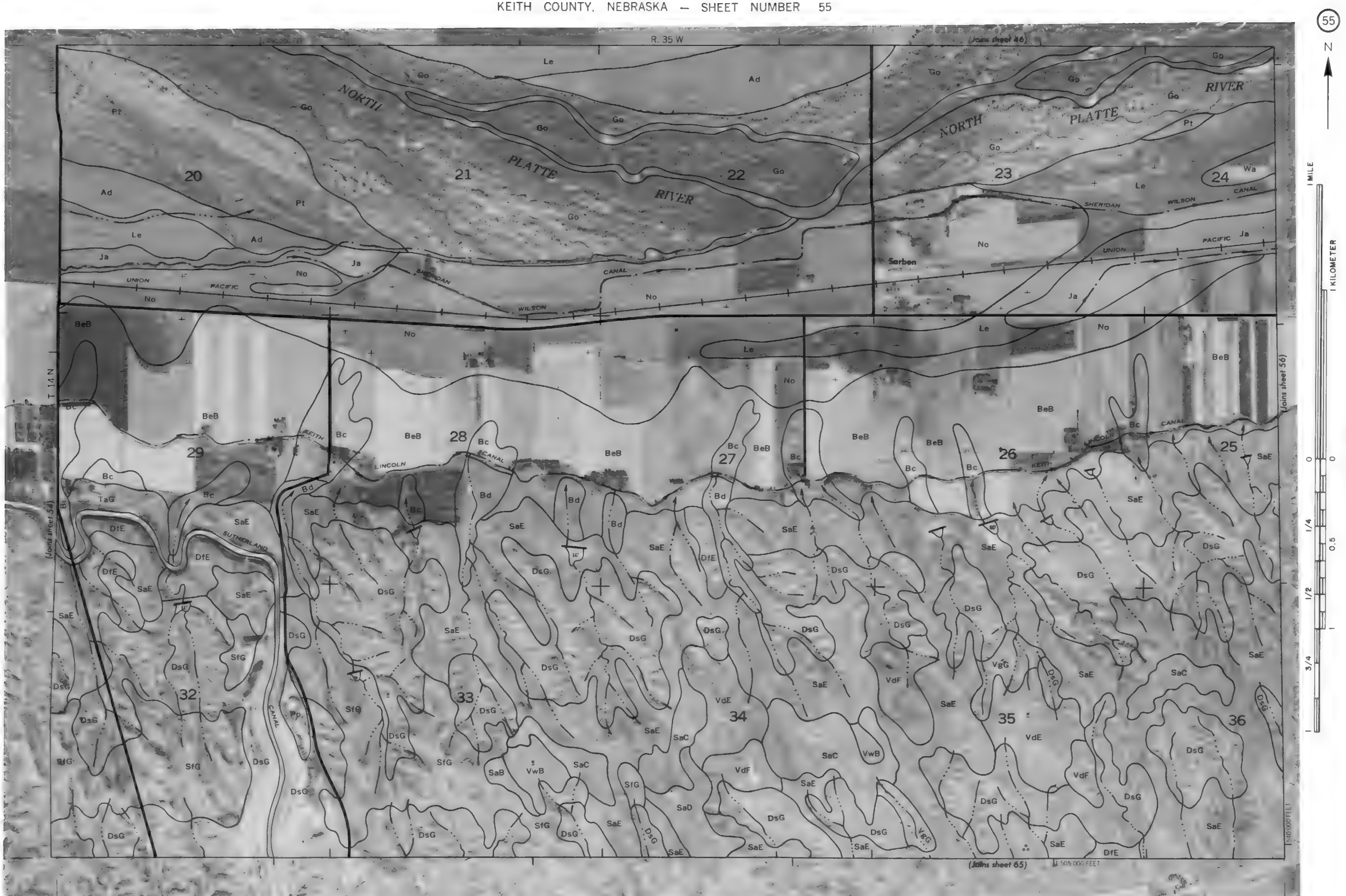

51
N
(Joins sheet 42)
R. 38 W.
(Joins sheet 52)
(Joins sheet 61)
(Joins sheet 50)
Radio Tower
20
21
22
23
24
25
26
27
28
29
32
33
34
35
36
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
1
0.5

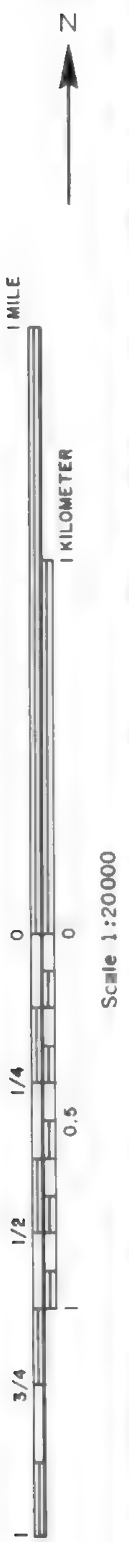

52
N
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
1
0
0.5
1
R. 38 W.
R. 37 W.
(Joins sheet 43)
(Joins sheet 51)
(Joins sheet 53)
(Joins sheet 62)
T. 14 N.
Radio Tower
19
20
21
22
24
25
27
28
29
30
31
32
33
34
36

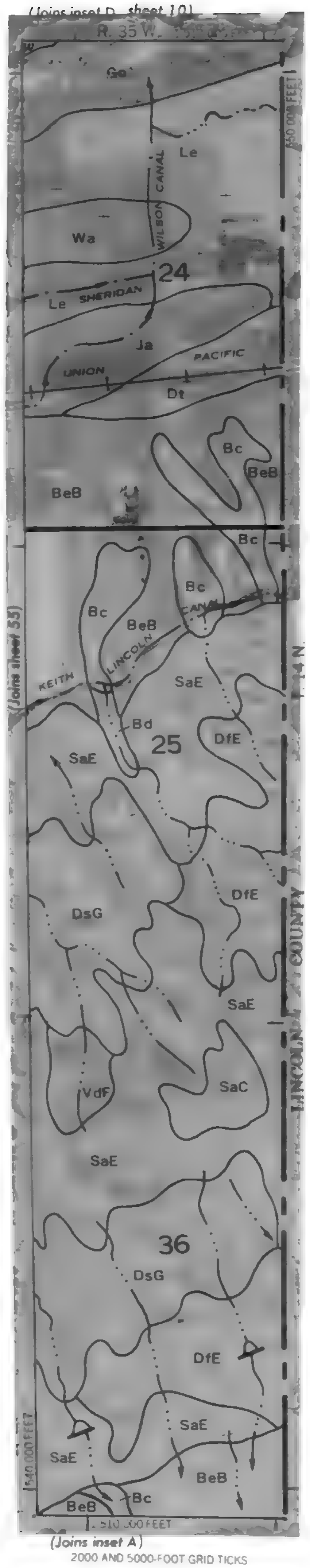

R. 37 W. | R. 36 W.
(Joins sheet 44)
(Joins sheet 63)
(Joins sheet 52)
(Joins sheet 54)
T. 14 N.
KEITH LINCOLN CANAL
SUTHERLAND CANAL
19
20
21
23
24
25
26
28
29
30
31
32
33
35
36
N
1 MILE
1 KILOMETER
Scale 1:20 000

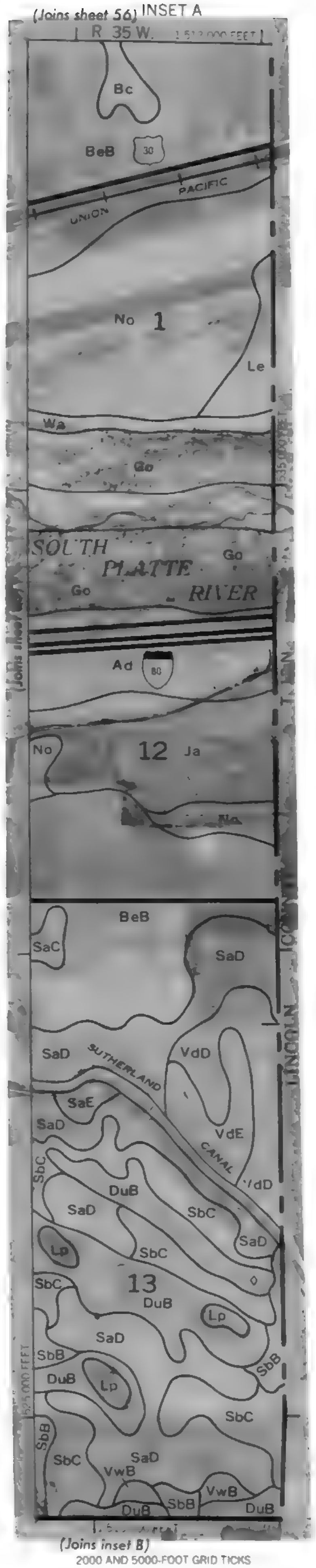
54

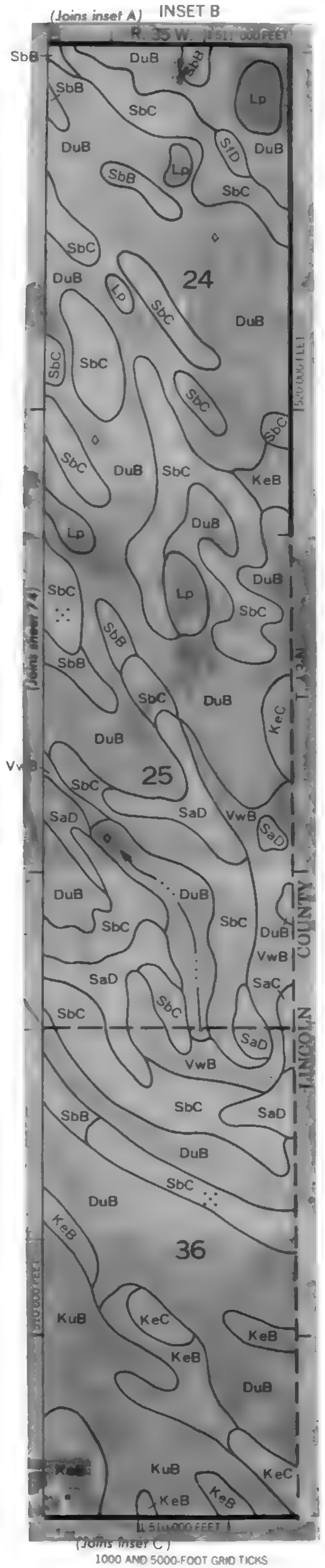

N
1 MILE
1 KILOMETER
0
1/4
1/2
3/4
1
0
0.5
1
Scale 1:20000
(Joins sheet 53)
(Joins sheet 55)
(Joins sheet 64)
NORTH PLATTE RIVER
Lake Ogallala
KEITH LINCOLN CANAL
UNION PACIFIC
21
22
23
24
19
28
27
26
25
30
33
34
35
36
31
Ad
Pt
Ja
Go
Dt
Le
BtB
Bs
BeB
Bc
No
TaG
Bd
SmF
SfG
DsG
DfE
SaE

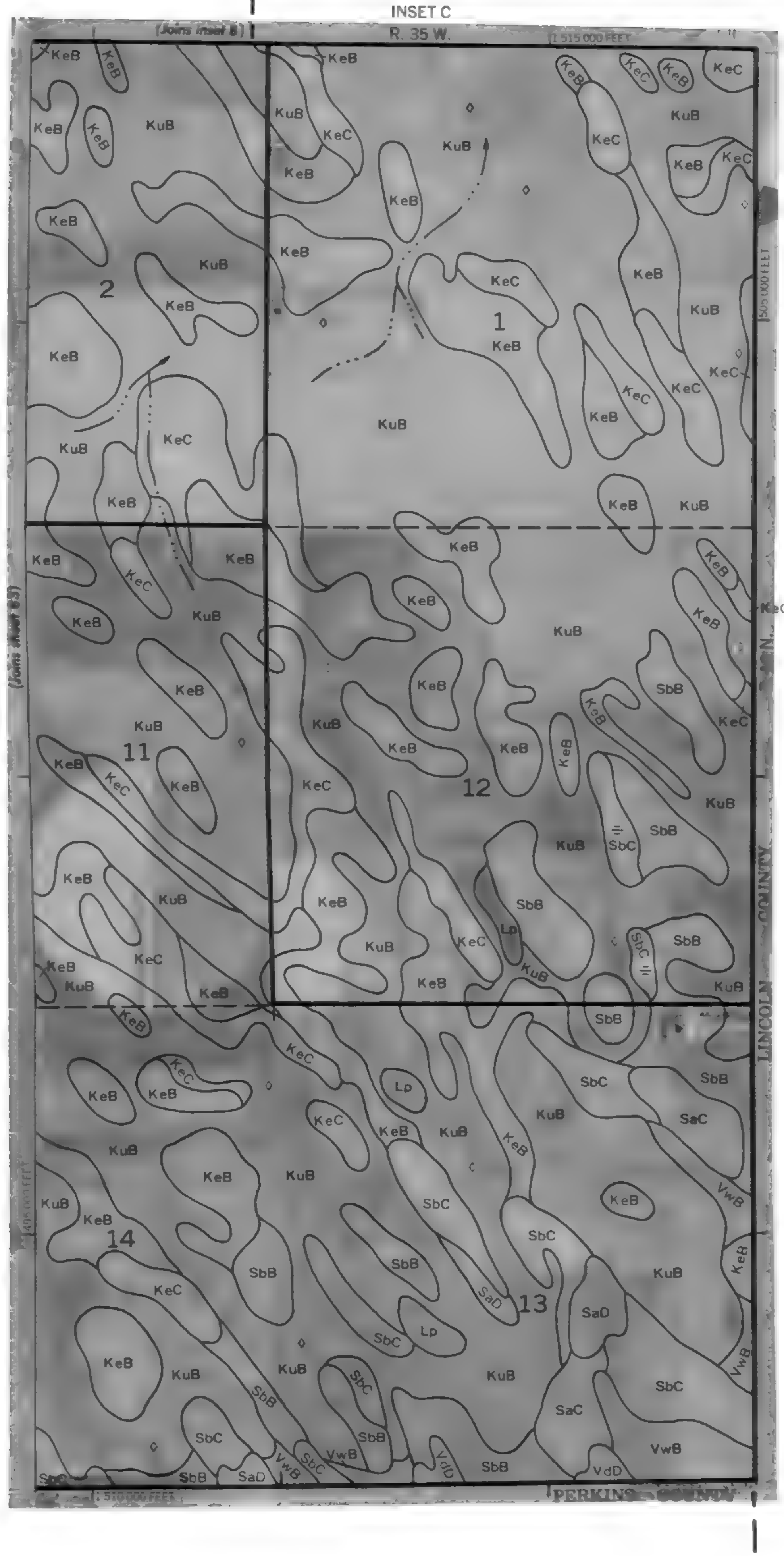

55
N
R. 35 W
(Joins sheet 46)
(Joins sheet 54)
(Joins sheet 56)
(Joins sheet 65)
T 14 N
1 505 000 FEET
NORTH PLATTE RIVER
NORTH PLATTE RIVER
SHERIDAN
WILSON
CANAL
UNION
PACIFIC
KEITH
LINCOLN
CANAL
SUTHERLAND
CANAL
Sarben
20
21
22
23
24
25
26
27
28
29
32
33
34
35
36
Le
Ad
Go
Pt
Ja
No
Wa
BeB
Bc
Bd
TaG
DfE
SaE
SaC
SaB
SaD
DsG
SfG
VdE
VdF
VwB
VgG
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
1
0.5


N
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
1
0
0.5
1

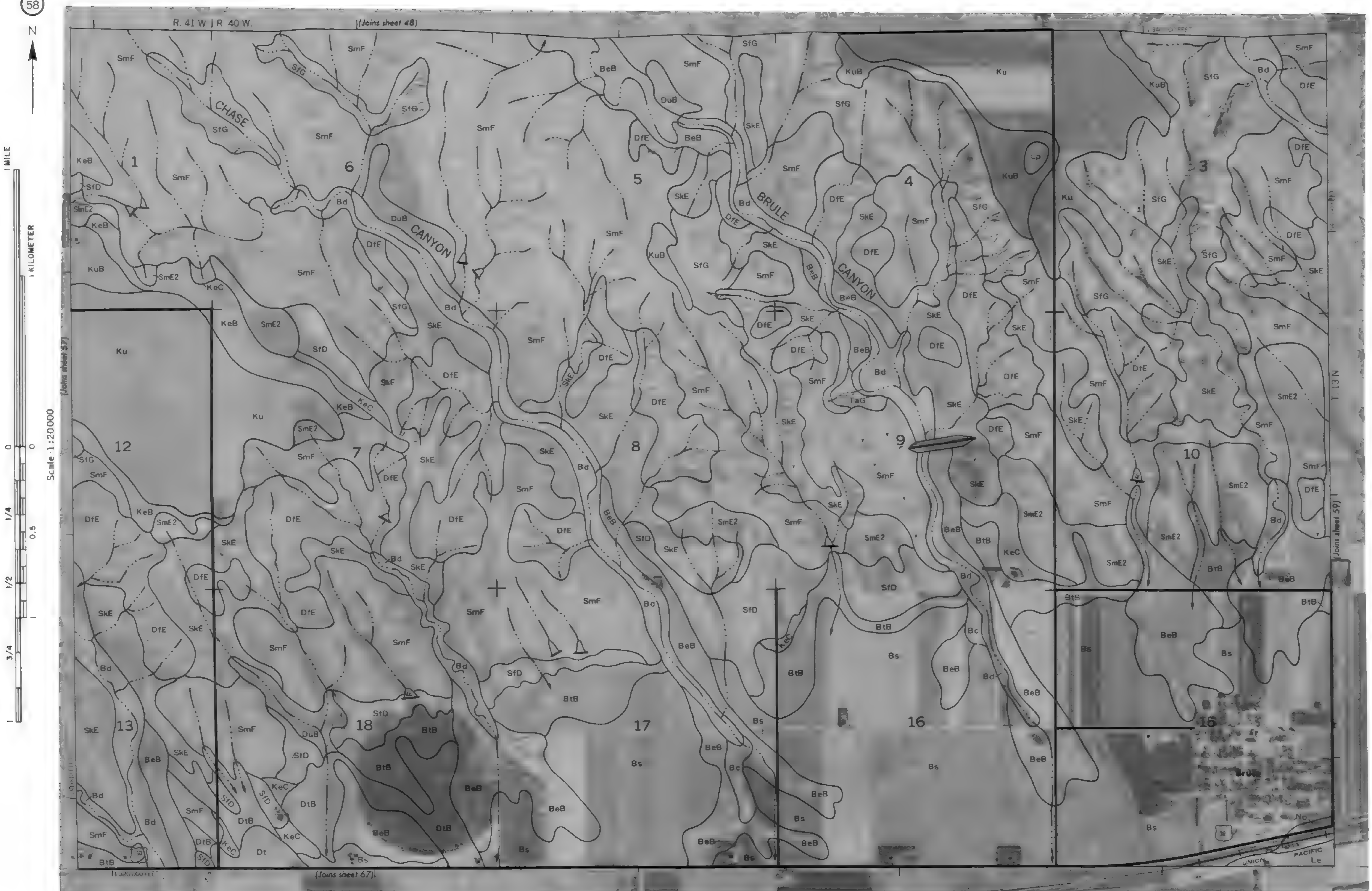

(Joins inset D, sheet 10)
R. 35 W.
(Joins sheet 55)
T. 14 N.
LINCOLN COUNTY
WILSON CANAL
SHERIDAN
UNION
PACIFIC
KEITH
LINCOLN
CANAL
24
25
36
(Joins inset A)
2000 AND 5000-FOOT GRID TICKS

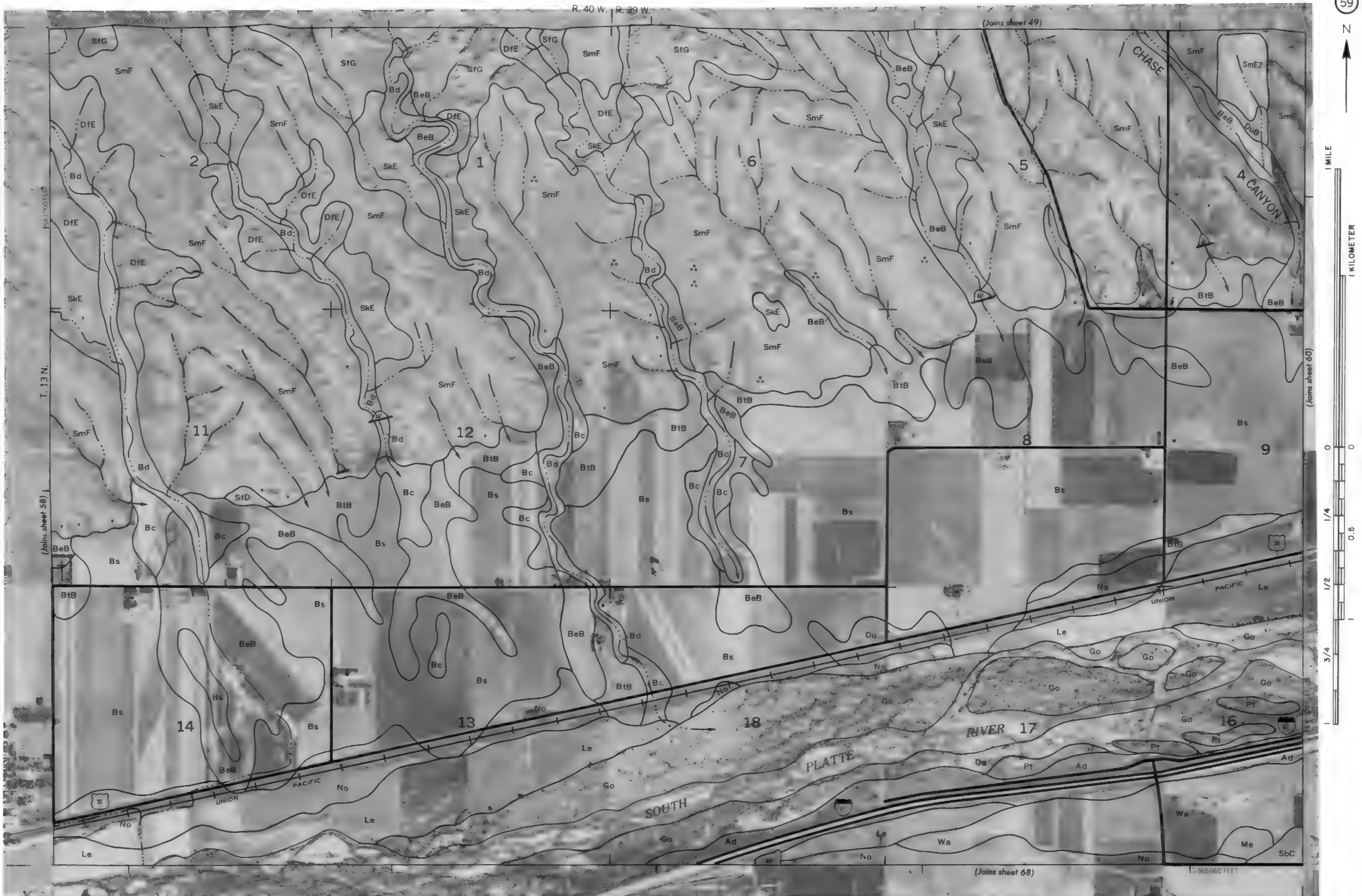

(Joins sheet 56)
INSET A
R. 35 W.
UNION
PACIFIC
SOUTH
PLATTE
RIVER
SUTHERLAND
CANAL
LINCOLN COUNTY
1
12
13
(Joins inset B)
2000 AND 5000-FOOT GRID TICKS

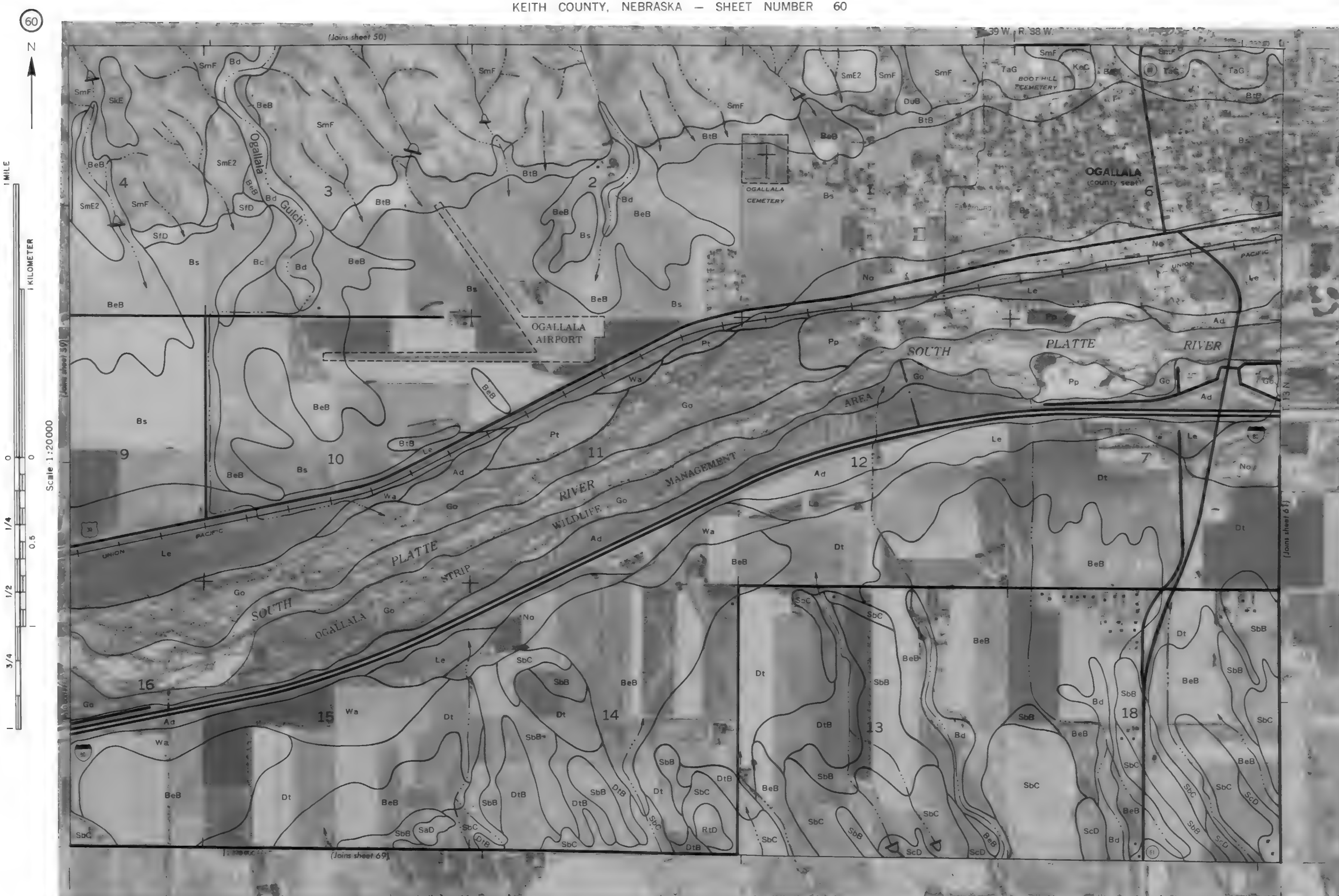

(Joins inset A)
INSET B
R. 35 W.
LINCOLN COUNTY
24
25
36
(Joins inset C)
1000 AND 5000-FOOT GRID TICKS


INSET C
(Joins inset B)
R. 35 W.
LINCOLN COUNTY
PERKINS COUNTY
2
1
11
12
14
13

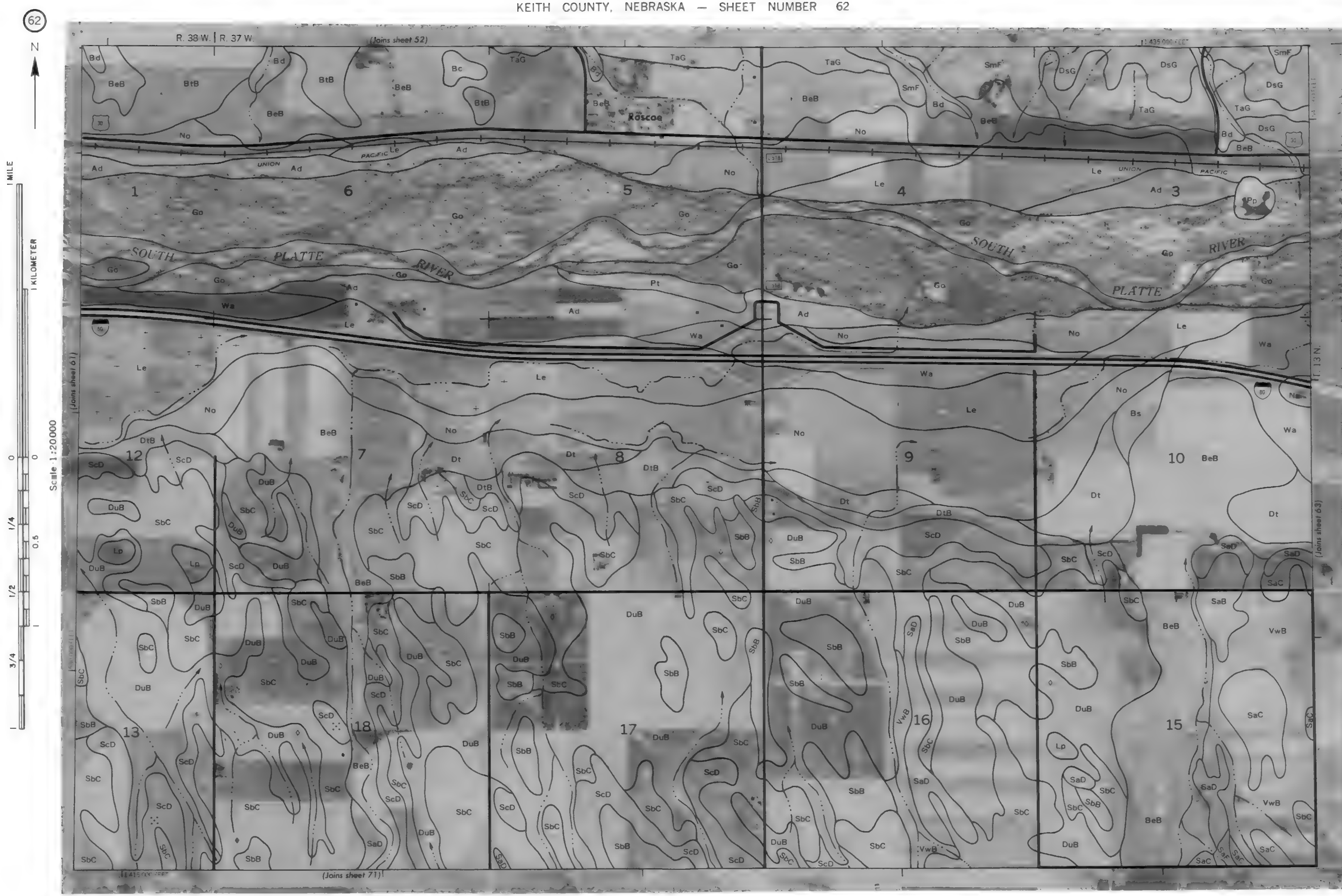

57
(Joins sheet 47)
(Joins sheet 58)
(Joins sheet 66)
R 41 W.
T 13 N
DEUEL COUNTY
N
1 MILE
1 KILOMETER
Scale 1:20000
1
2
3
4
5
8
9
10
11
12
13
14
15
16
17


N
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
1
0
0.5
1
R. 41 W. | R. 40 W.
(Joins sheet 48)
(Joins sheet 57)
(Joins sheet 59)
(Joins sheet 67)
T. 13 N.
CHASE CANYON
BRULE CANYON
UNION PACIFIC
Brule
1
3
4
5
6
7
8
9
10
12
13
16
17
18
SmF
SfG
SfD
SkE
DfE
Bd
BeB
BtB
Bs
Bc
KeB
KeC
KuB
Ku
DuB
DtB
Dt
SmE2
TaG
Lp
Le


R. 40 W.
R. 39 W.
(Joins sheet 49)
(Joins sheet 58)
(Joins sheet 60)
(Joins sheet 68)
T. 13 N.
CHASE
CANYON
SOUTH
PLATTE
RIVER
UNION
PACIFIC
59
N
1 MILE
1 KILOMETER
Scale 1:20000


60
N
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
1
0
0.5
1
(Joins sheet 50)
(Joins sheet 59)
(Joins sheet 61)
(Joins sheet 69)
R. 39 W. | R. 38 W.
T. 13 N.
OGALLALA
(county seat)
OGALLALA CEMETERY
BOOT HILL CEMETERY
OGALLALA AIRPORT
Ogallala Gulch
SOUTH PLATTE RIVER
SOUTH PLATTE RIVER WILDLIFE MANAGEMENT AREA
OGALLALA STRIP
UNION PACIFIC
SmF
Bd
SkE
BeB
SmE2
SfD
SfD
Bs
Bc
BtB
SmF
DuB
TaG
KeC
No
Le
Pp
Go
Ad
Pt
Wa
Dt
SbC
SbB
DtB
ScD
SaD
RtD
1
2
3
4
6
7
9
10
11
12
13
14
15
16
18

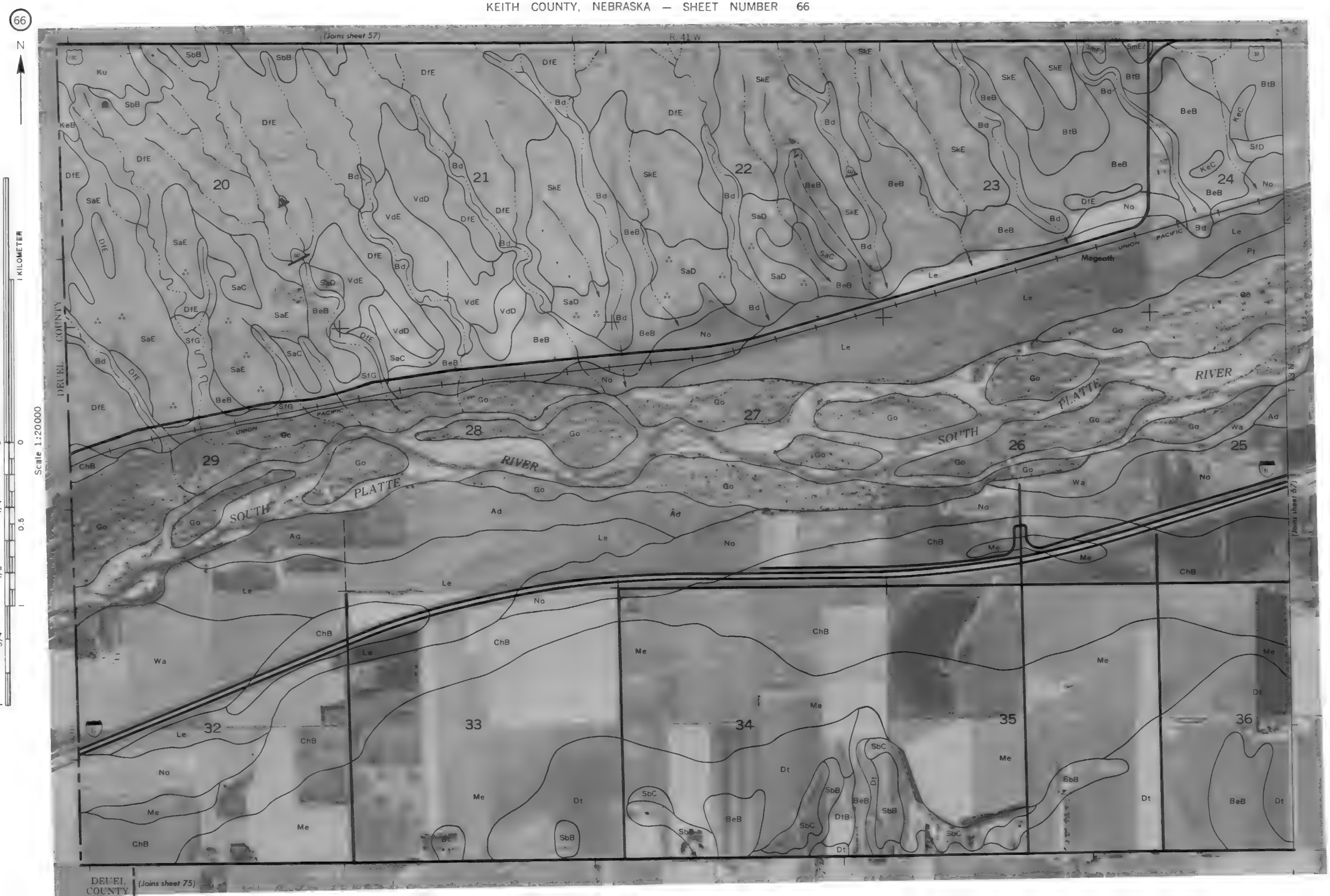

61
N
R. 38 W.
(Joins sheet 51)
(Joins sheet 60)
(Joins sheet 62)
(Joins sheet 70)
OGALLALA
COUNTY SEAT
Radio Tower
UNION PACIFIC
SEWAGE DISPOSAL
SOUTH PLATTE RIVER
Happy Hollow
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
1
0.5
1
2
3
4
5
8
9
10
11
12
13
14
15
16
17
TaG
BtB
BeB
Bs
No
Ad
Go
Pp
Wa
Le
Dt
DtB
SbB
SbC
ScD
Bd
Lp
DuB
AwF

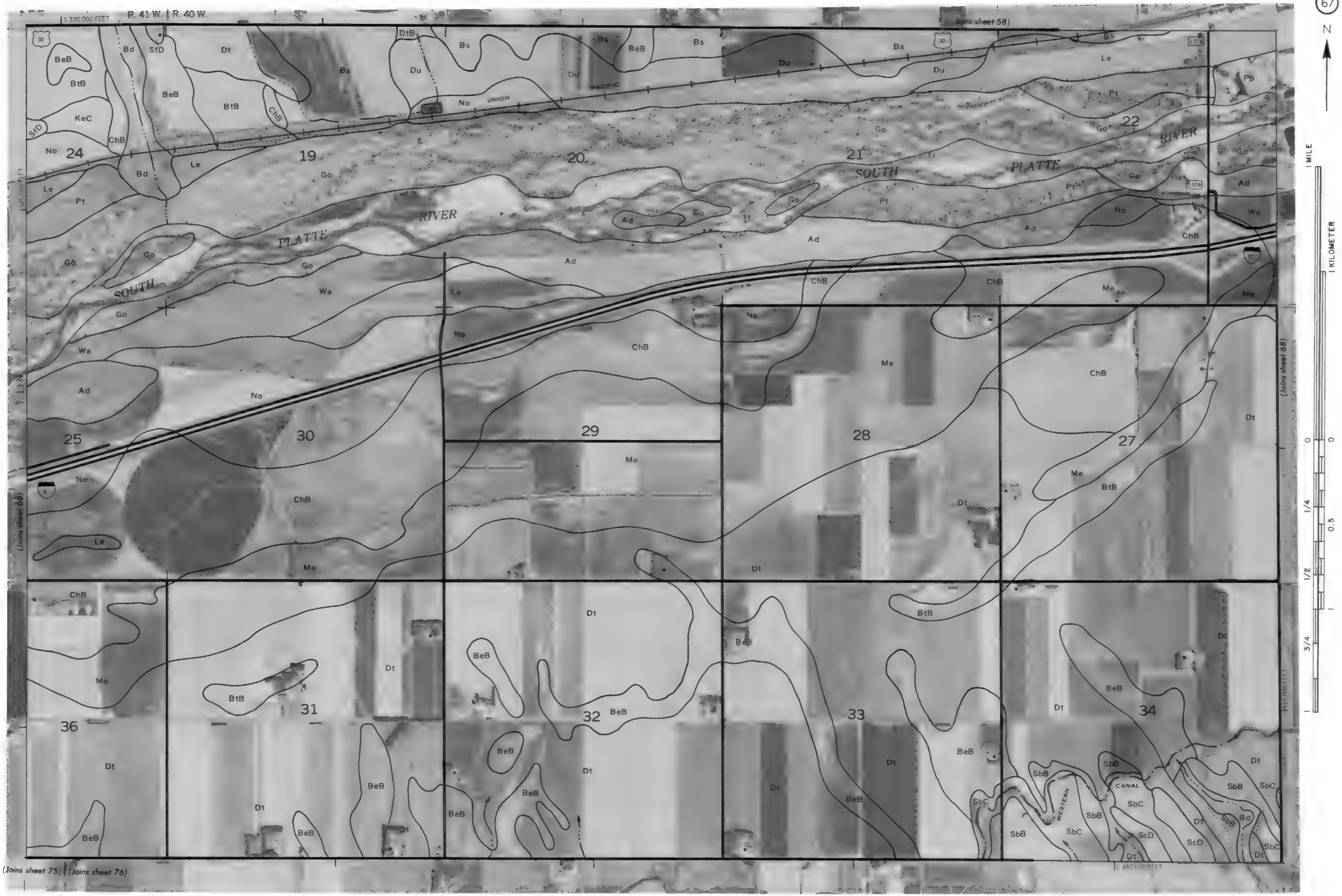

62
N
R. 38 W.
R. 37 W.
(Joins sheet 52)
(Joins sheet 61)
(Joins sheet 63)
(Joins sheet 71)
T. 13 N.
Roscoe
UNION PACIFIC
SOUTH PLATTE RIVER
1 MILE
1 KILOMETER
Scale 1:20000

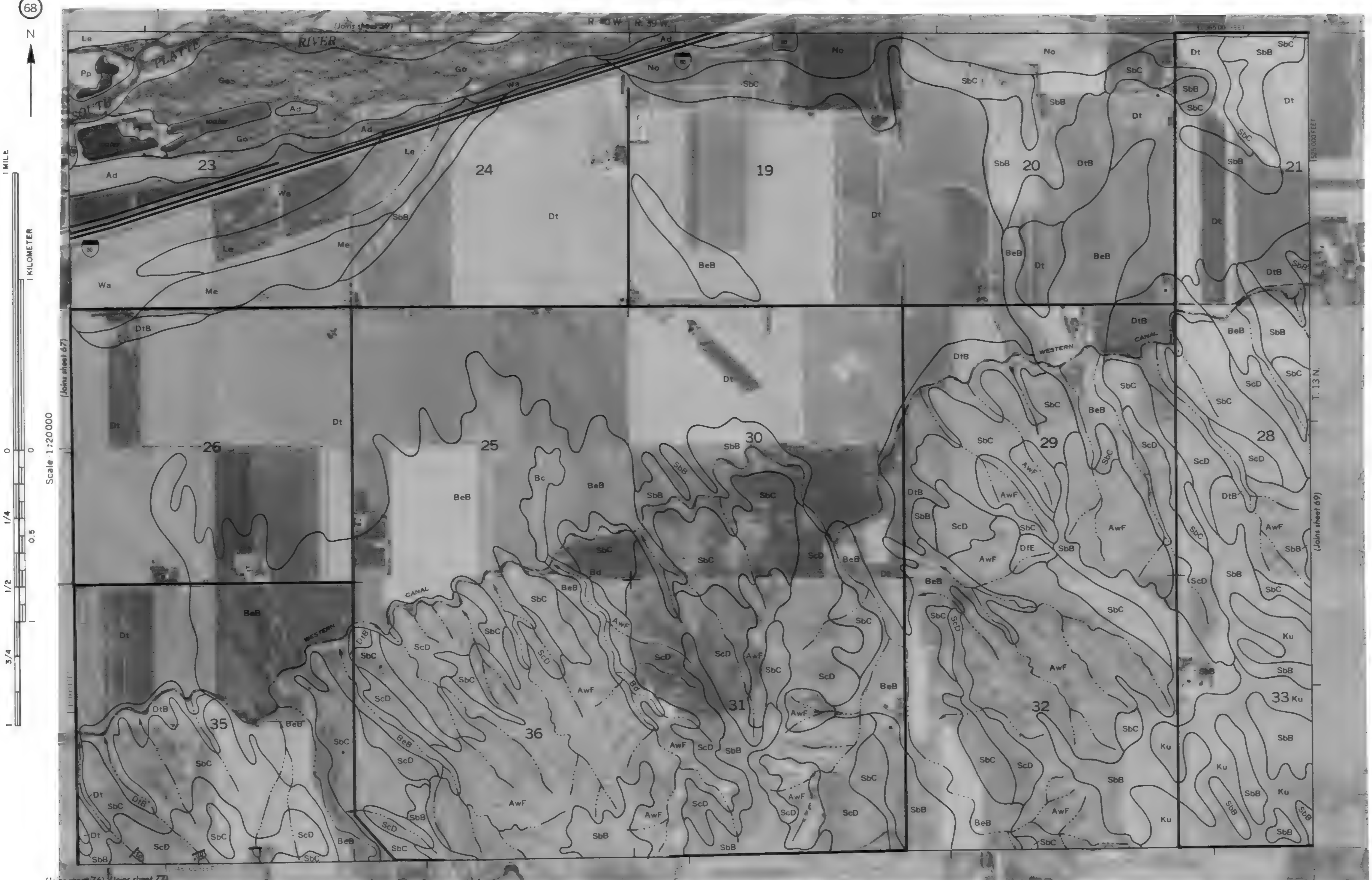

63
N
R. 37 W. | R. 36 W.
(Joins sheet 53)
(Joins sheet 72)
(Joins sheet 62)
(Joins sheet 64)
1 440 000 FEET
1 460 000 FEET
T. 13 N.
UNION PACIFIC
SOUTH PLATTE RIVER
KORTY DIVERSION DAM
SOUTH PLATTE SUPPLY CANAL
water
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
1
0.5

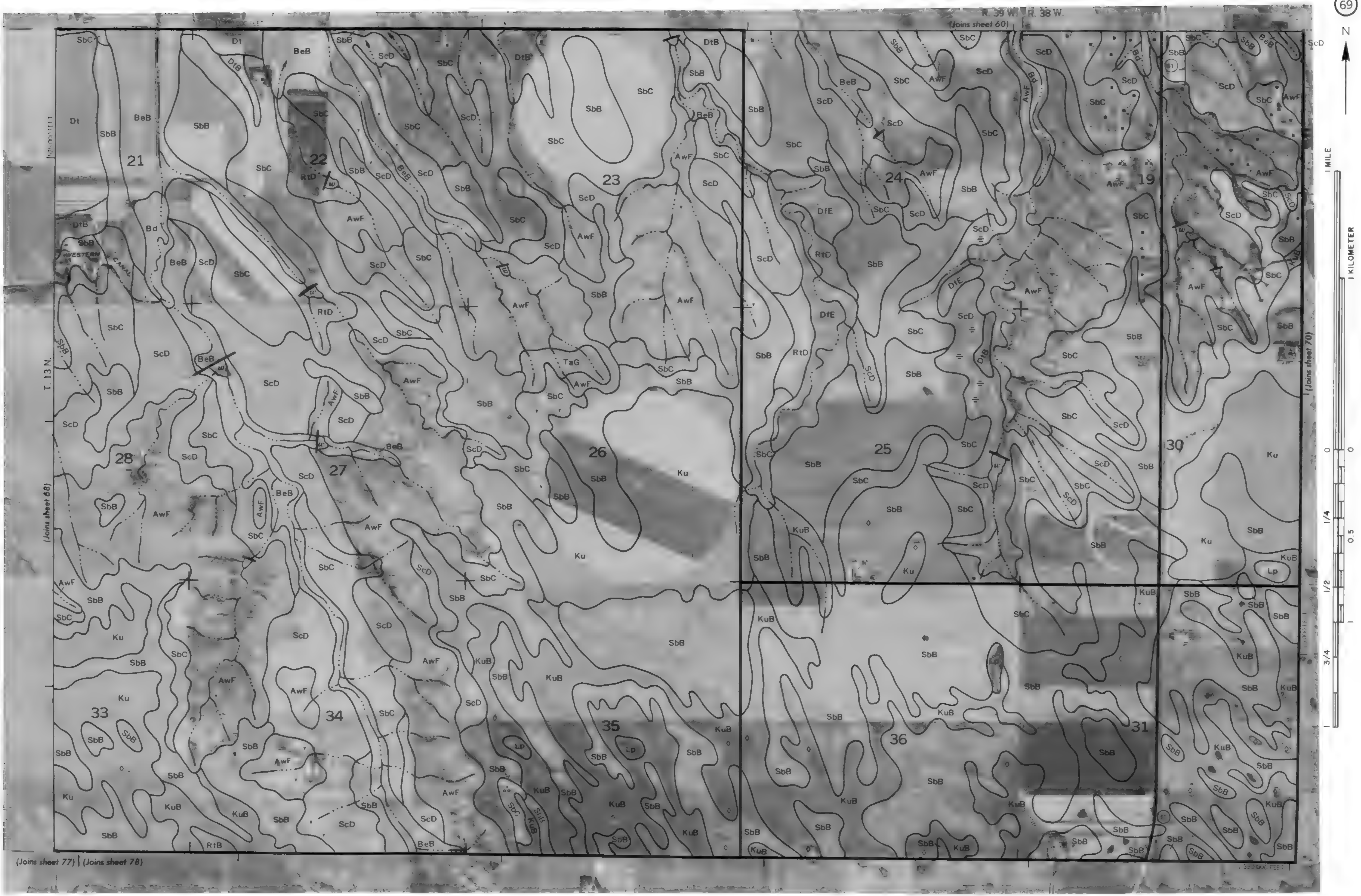

64
N
1 MILE
1 KILOMETER
Scale 1:20000
(Joins sheet 54)
(Joins sheet 63)
(Joins sheet 65)
(Joins sheet 73)
R. 36 W. | R. 35 W.
T. 13 N.
UNION PACIFIC
SOUTH PLATTE RIVER
SOUTH PLATTE SUPPLY CANAL
DsG
SkE
SfG
BeB
Bc
Bd
SaE
Le
No
Go
Ad
Pt
Ja
Wa
La
Ma
SaD
SbC
SbB
DuB
Lp
VwB
SaC
VdD
VdF
1
2
3
4
6
7
9
10
11
12
13
14
15
16
18


65
N
(Joins sheet 55)
(Joins sheet 74)
(Joins sheet 64)
(Joins inset A, sheet 56)
R. 35 W.
T. 13 N.
1 490 000 FEET
Paxton
SUTHERLAND CANAL
SEWAGE DISPOSAL
UNION PACIFIC
SOUTH PLATTE RIVER
SIPHON
PAXTON CEMETERY
SOUTH PLATTE SUPPLY CANAL
SUTHERLAND CANAL
1 MILE
1 KILOMETER
Scale 1:20000
1
2
3
4
5
8
9
10
11
12
13
14
15
16
17

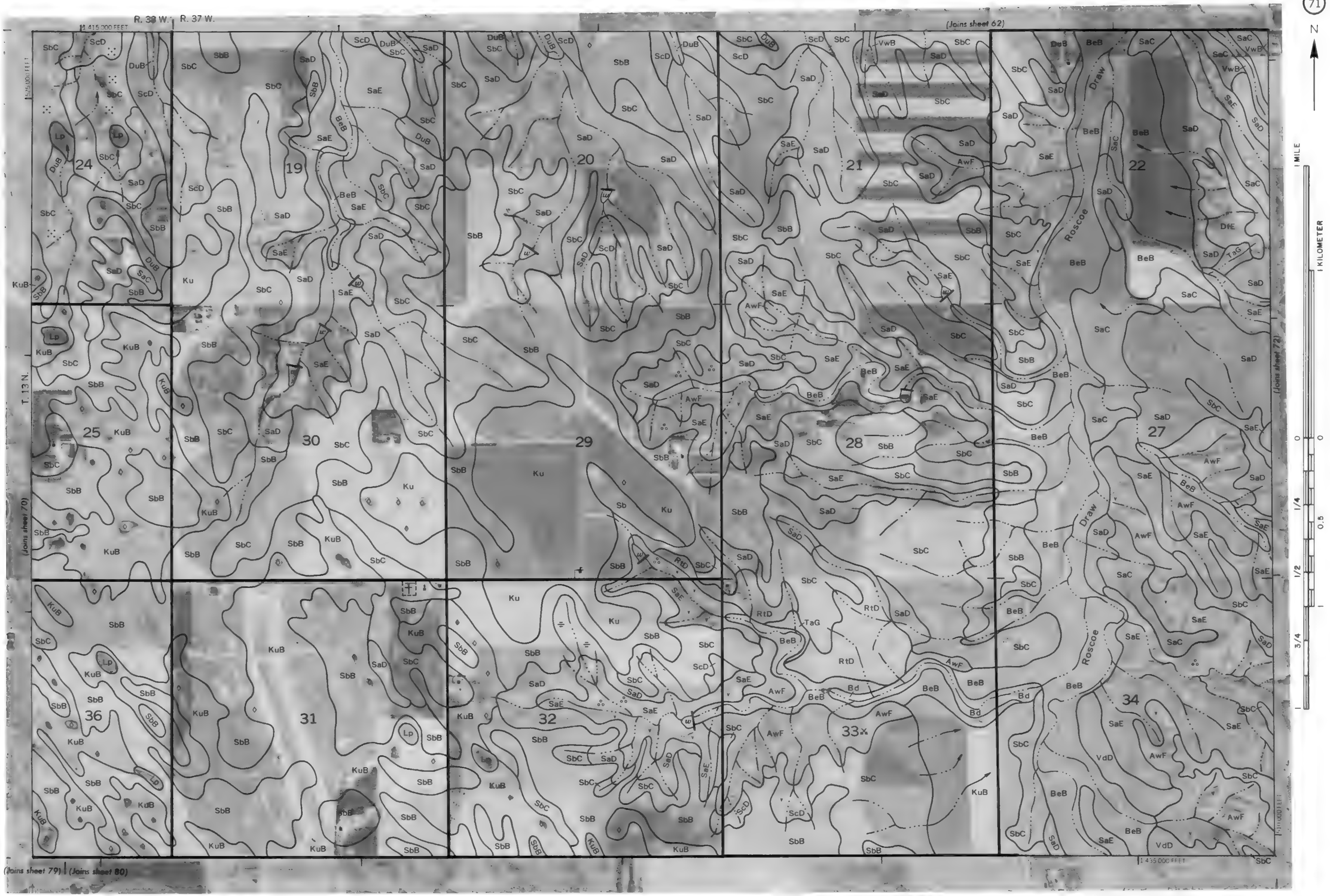

66
N
1 MILE
1 KILOMETER
Scale 1:20000
(Joins sheet 57)
R. 41 W.
(Joins sheet 67)
(Joins sheet 75)
DEUEL COUNTY
T. 13 N.
SOUTH PLATTE RIVER
UNION PACIFIC
Megeath
20
21
22
23
24
25
26
27
28
29
32
33
34
35
36


67
N
R. 41 W. | R. 40 W.
(Joins sheet 58)
(Joins sheet 66)
(Joins sheet 68)
(Joins sheet 75)
(Joins sheet 76)
UNION
PACIFIC
SOUTH PLATTE RIVER
WESTERN CANAL
19
20
21
22
24
25
27
28
29
30
31
32
33
34
36
1 MILE
1 KILOMETER
Scale 1:20000

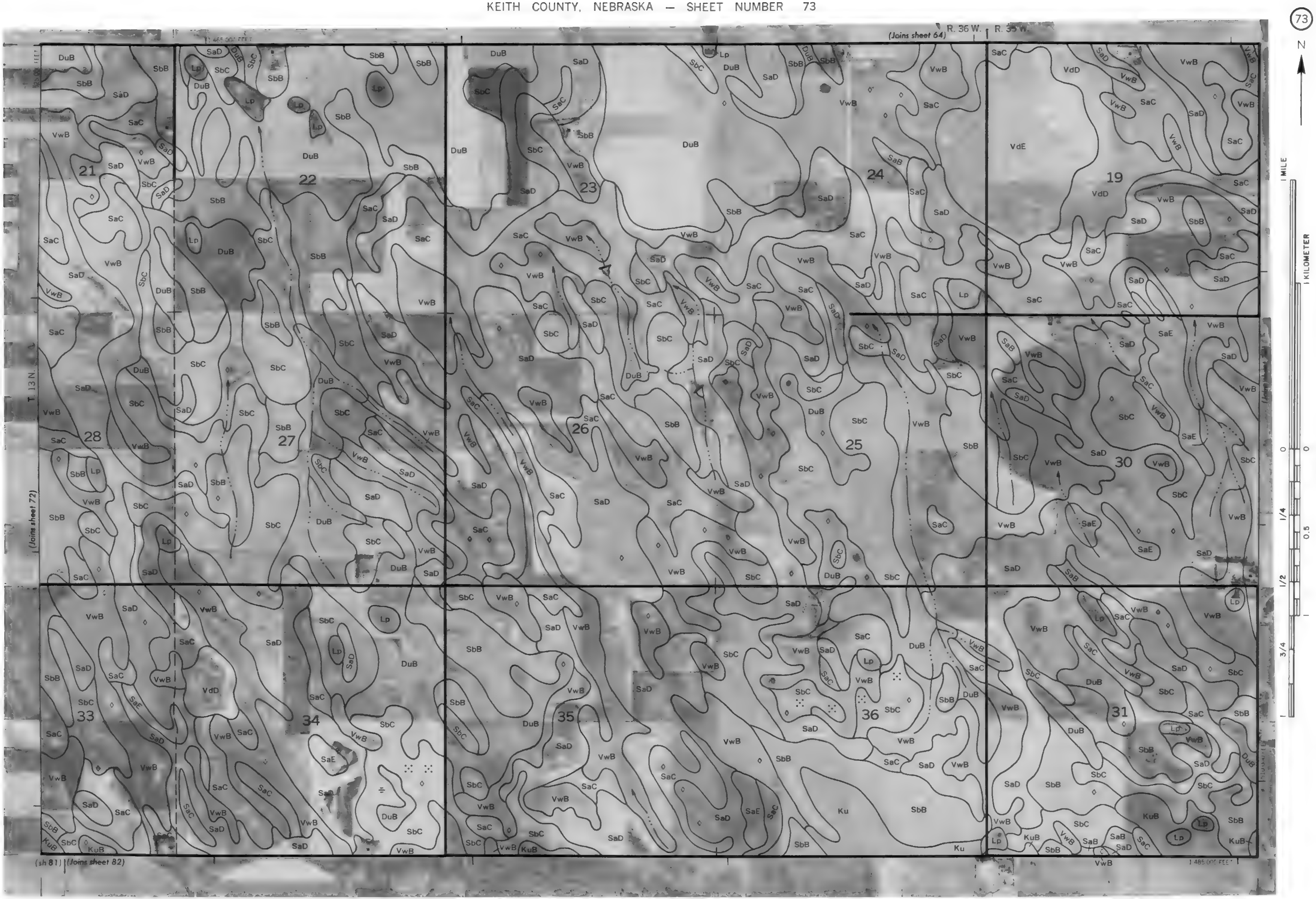

68
N
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
1
0
0.5
1
(Joins sheet 59)
R. 40 W.
R. 39 W.
SOUTH PLATTE RIVER
water
(Joins sheet 67)
(Joins sheet 69)
T. 13 N.
WESTERN CANAL
(Joins sheet 76)
(Joins sheet 77)
19
20
21
23
24
25
26
28
29
30
31
32
33
35
36
Le
Pp
Go
Ad
Wa
Me
No
Dt
DtB
SbB
SbC
BeB
Bc
Bd
ScD
AwF
DfE
Ku

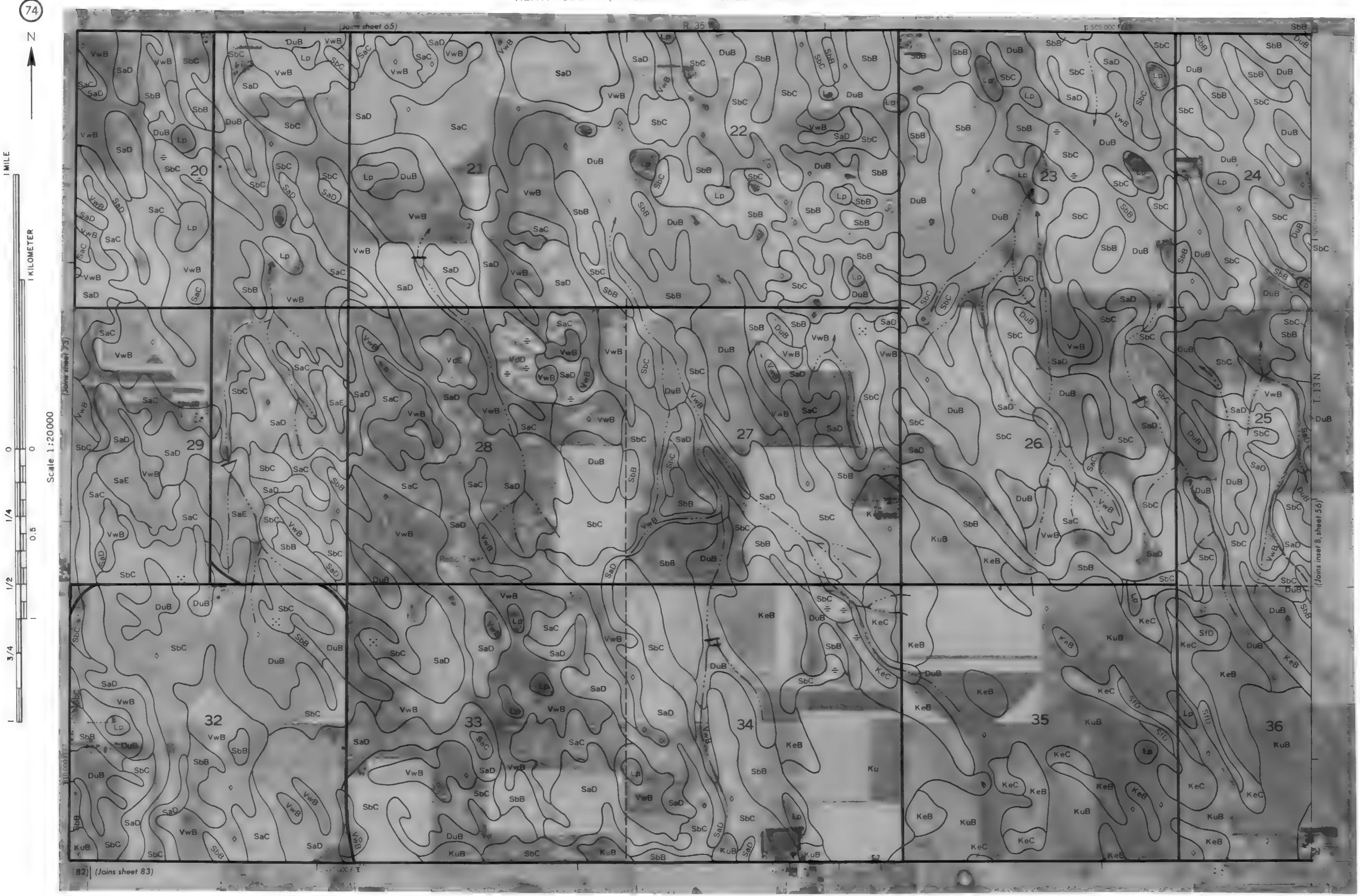

69
N
R. 39 W. | R. 38 W.
(Joins sheet 60)
(Joins sheet 70)
(Joins sheet 68)
(Joins sheet 77) | (Joins sheet 78)
T. 13 N.
WESTERN CANAL
21
22
23
24
19
28
27
26
25
30
33
34
35
36
31
1 MILE
1 KILOMETER
0
1/4
1/2
3/4
0
0.5
Scale 1:20 000

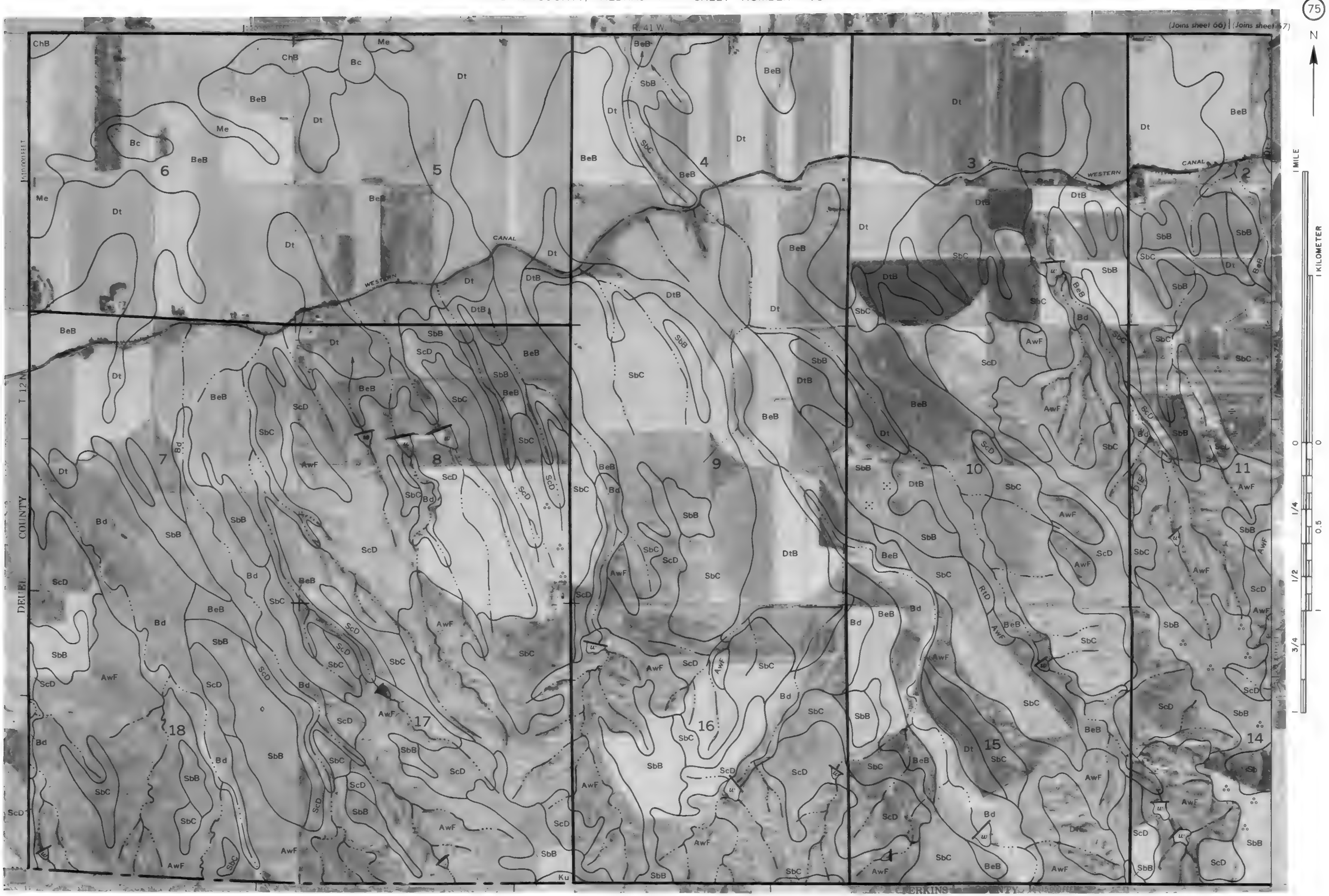

N
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
0.5
(Joins sheet 61)
R. 38 W.
T. 13 N.
(Joins sheet 69)
(Joins sheet 71)
(Joins sheet 78)
(Joins sheet 79)
Happy Hollow
20
21
22
23
24
25
26
27
28
29
32
33
34
35
36
AwF
BeB
Bd
DuB
KuB
Ku
Lp
SbB
SbC
ScD
TaG

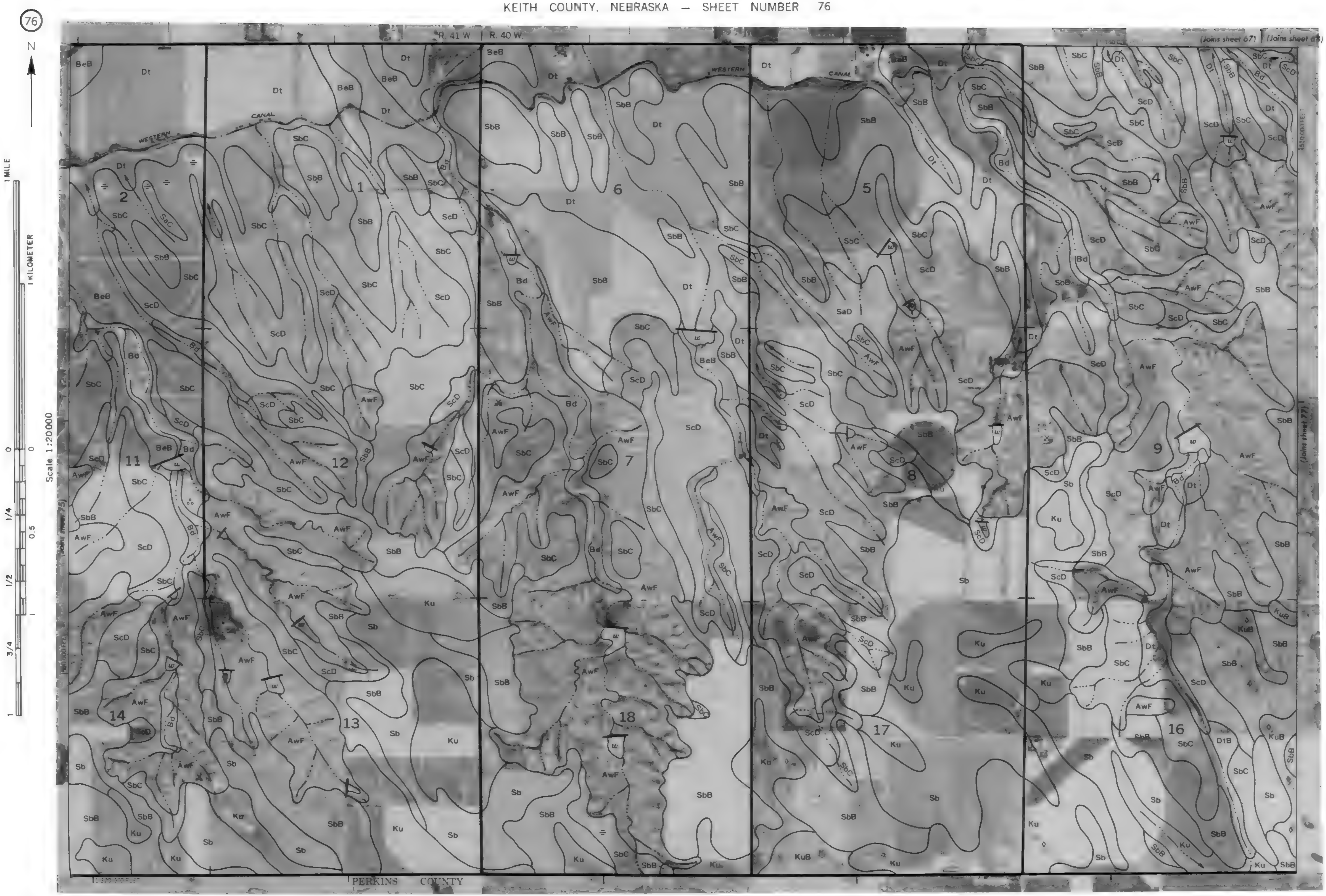

R. 38 W.
R. 37 W.
1 415 000 FEET
(Joins sheet 62)
T. 13 N.
(Joins sheet 70)
(Joins sheet 72)
(Joins sheet 79)
(Joins sheet 80)
1 435 000 FEET
Roscoe Draw
24
19
20
21
22
25
30
29
28
27
36
31
32
33
34
N
1 MILE
1 KILOMETER
Scale 1:20 000

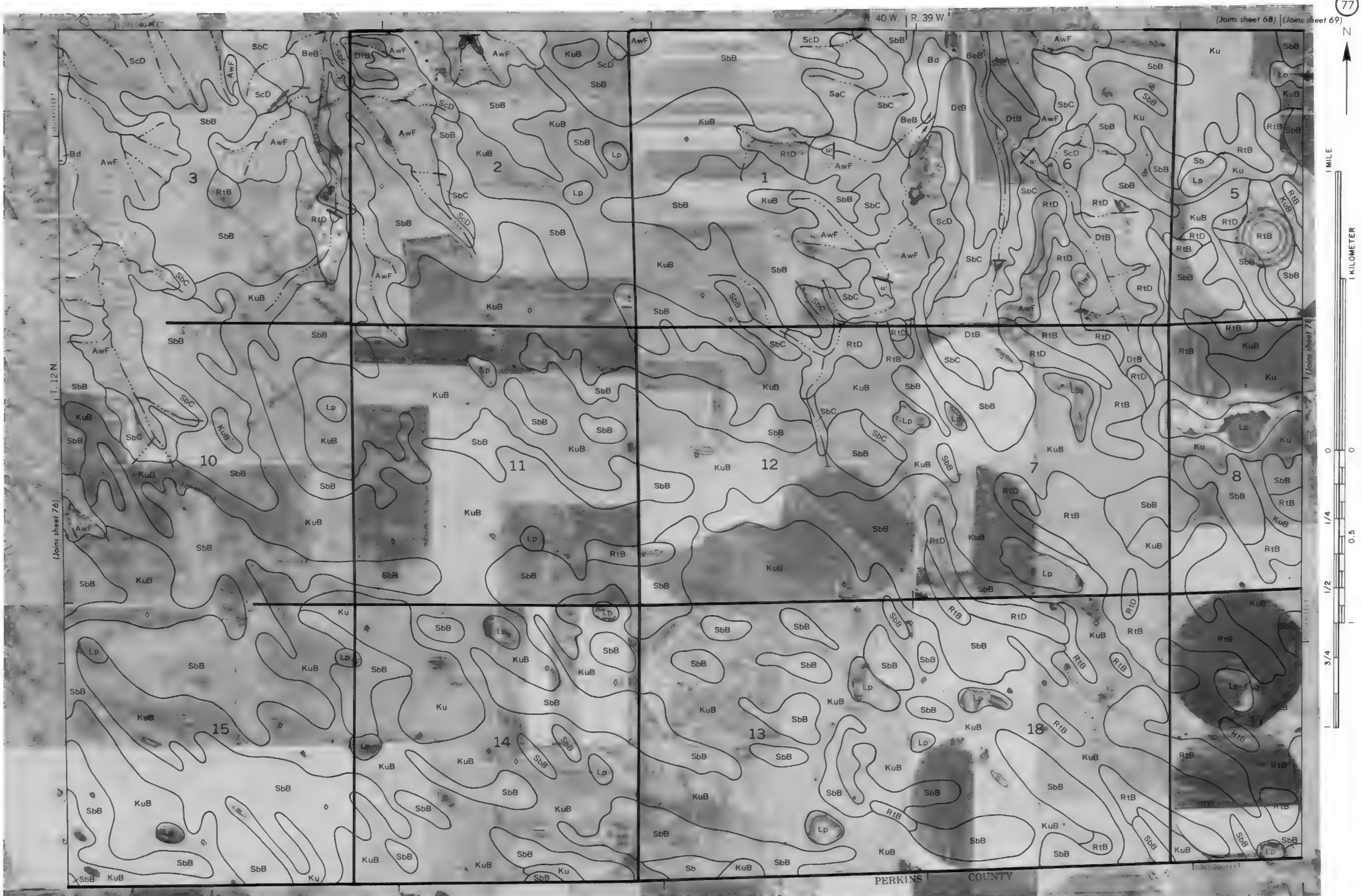

N
1 MILE
1 KILOMETER
Scale 1:20000
(Joins sheet 63)
R. 37 W.
R. 36 W.
(Joins sheet 71)
(Joins sheet 73)
T. 13 N.
(Joins sheet 80)
(Joins sheet 81)
23
24
19
20
21
26
25
30
29
28
35
36
31
32
33


73
N
(Joins sheet 64)
R. 36 W. | R. 35 W.
T. 13 N.
(Joins sheet 72)
(sh 81) (Joins sheet 82)
1 485 000 FEET
21
22
23
24
19
28
27
26
25
30
33
34
35
36
31
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
1
0.5


74
N
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
1
0.5
(Joins sheet 65)
R. 35 W.
(Joins sheet 73)
(Joins inset 8, sheet 56)
T. 13 N.
(82)
(Joins sheet 83)
20
21
22
23
24
29
28
27
26
25
32
33
34
35
36
Radio Tower

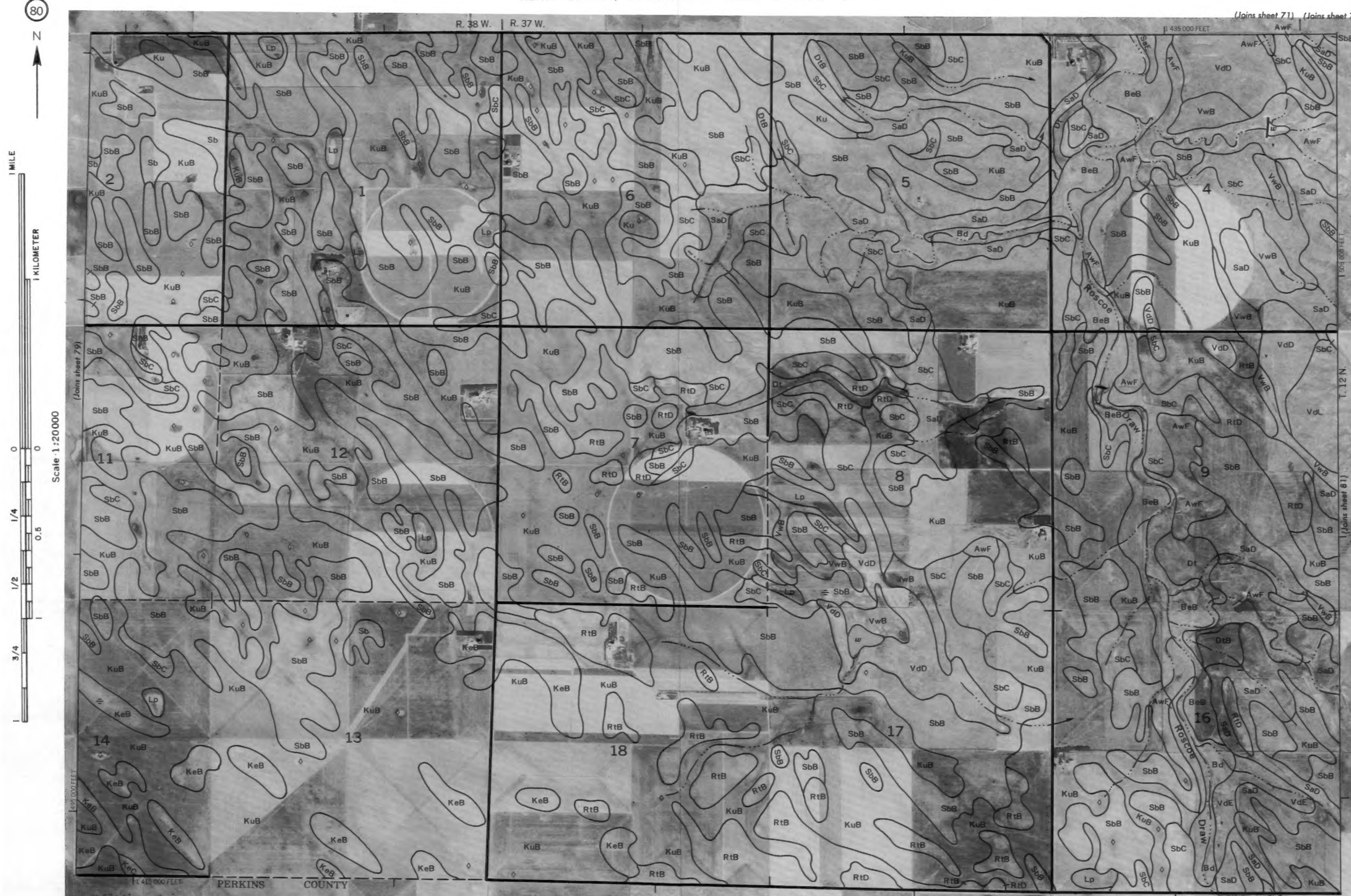

75
(Joins sheet 66)
(Joins sheet 67)
R. 41 W.
T. 12 N.
DEUEL COUNTY
PERKINS COUNTY
WESTERN CANAL
N
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
1
0.5

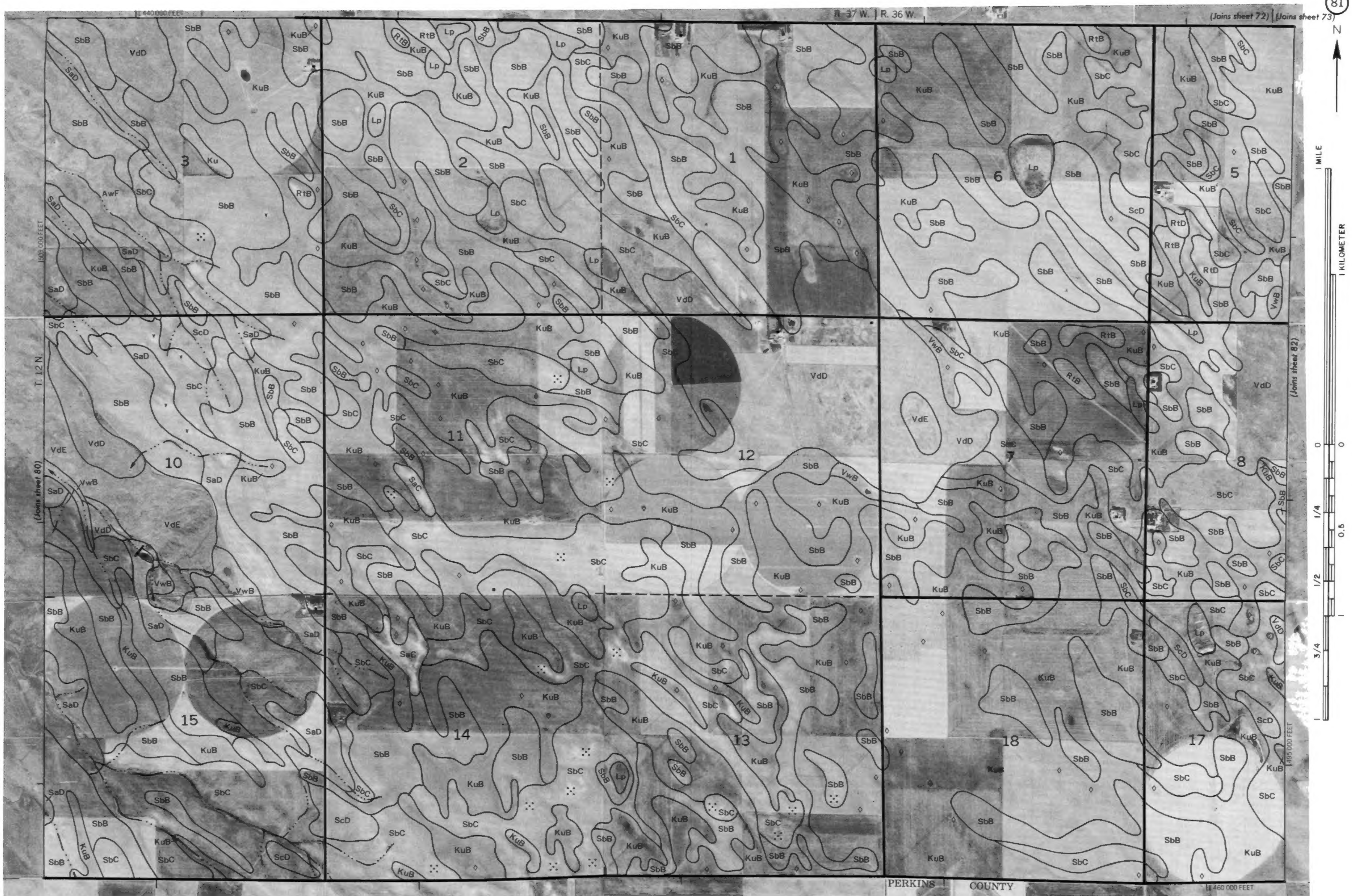

76
N
1 MILE
1 KILOMETER
Scale 1:20000
R. 41 W.
R. 40 W.
WESTERN
CANAL
PERKINS COUNTY
(Joins sheet 67)
(Joins sheet 68)
(Joins sheet 77)
(Joins sheet 75)

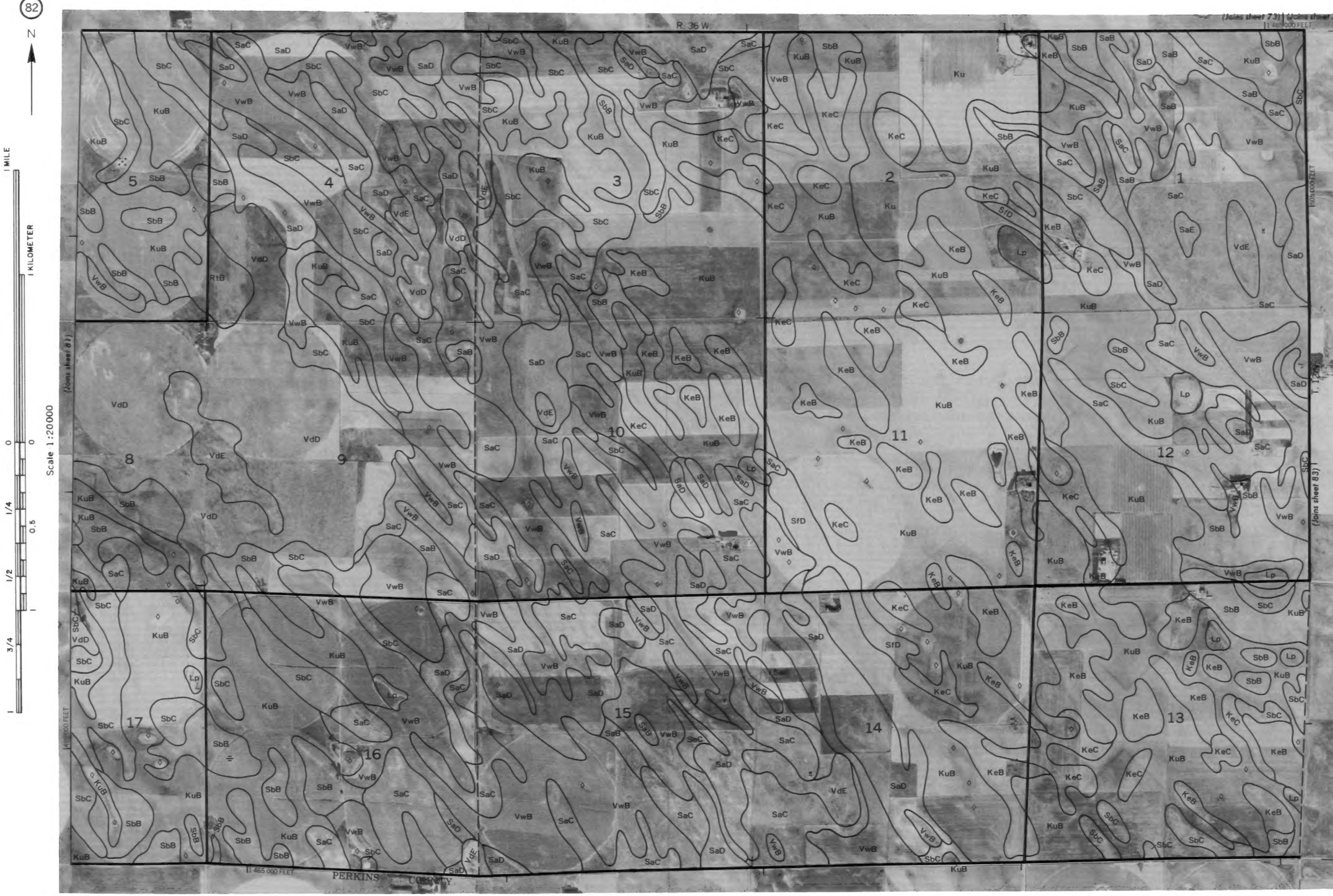

77
(Joins sheet 68)
(Joins sheet 69)
(Joins sheet 76)
(Joins sheet 78)
40 W.
R. 39 W.
T. 12 N.
PERKINS COUNTY
N
1 MILE
1 KILOMETER
Scale 1:20000

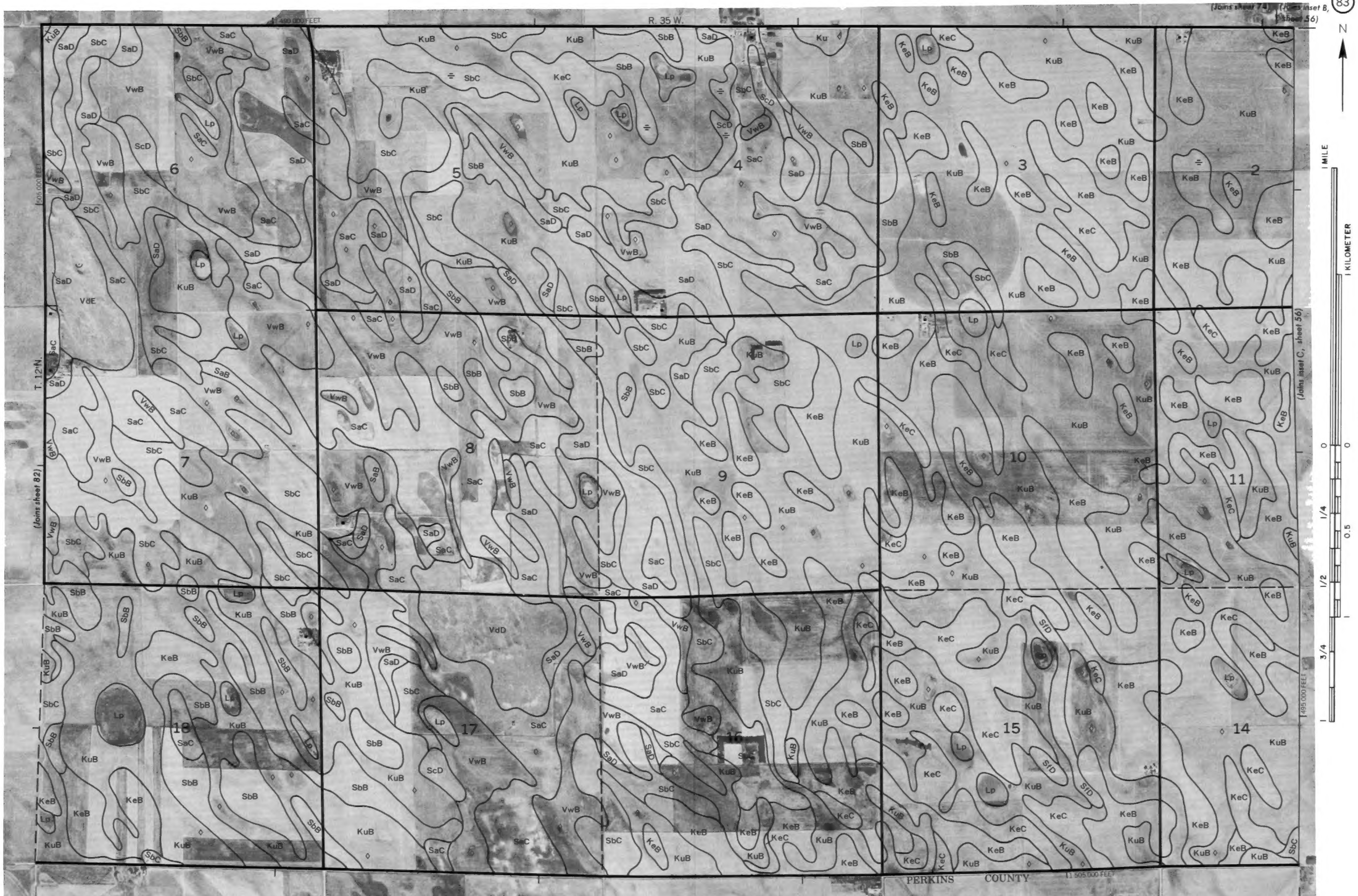

N
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
1
0
0.5
1
R. 39 W.
(Joins sheet 69)
(Joins sheet 70)
T. 12 N.
(Joins sheet 79)
PERKINS COUNTY
1
2
3
4
5
8
9
10
11
12
13
14
15
16
17


79
N
(Joins sheet 70)
(sh 71)
(Joins sheet 80)
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
1
0.5
PERKINS COUNTY
Radio Tower
1 2 3 4 5 6 7 8 9 10 11 14 15 16 17 18


80
N
R. 38 W.
R. 37 W.
(Joins sheet 71)
(Joins sheet 72)
(Joins sheet 79)
(Joins sheet 81)
T. 12 N.
1 MILE
1 KILOMETER
Scale 1:20000
PERKINS
COUNTY
Roscoe
Draw
1 435 000 FEET
1 415 000 FEET


81
N
(Joins sheet 72)
(Joins sheet 73)
(Joins sheet 80)
(Joins sheet 82)
R. 37 W.
R. 36 W.
T. 12 N.
440 000 FEET
460 000 FEET
495 000 FEET
PERKINS COUNTY
1 MILE
1 KILOMETER
0
1/4
1/2
3/4
0.5
Scale 1:20000
1
2
3
5
6
7
8
10
11
12
13
14
15
17
18


82
N
1 MILE
1 KILOMETER
Scale 1:20000
R. 36 W.
(Joins sheet 73)
(Joins sheet 74)
(Joins sheet 81)
(Joins sheet 83)
1 485 000 FEET
1 465 000 FEET
PERKINS COUNTY


83
N
R. 35 W.
T. 12 N.
(Joins sheet 74)
(Joins inset B, sheet 56)
(Joins inset C, sheet 56)
(Joins sheet 82)
PERKINS COUNTY
1 MILE
1 KILOMETER
Scale 1:20000
490 000 FEET
505 000 FEET
495 000 FEET
1 505 000 FEET
2
3
4
5
6
7
8
9
10
11
14
15
16
17
18